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CONSTRUCTION QUALITY MANAGEMENT FOR CONTRACTORS

Student Study Guide

Produced By:
U.S. Army Corps of Engineers
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CONSTRUCTION QUALITY MANAGEMENT FOR CONTRACTORS

STUDENT STUDY GUIDE

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Recommended References (Not included in text)

CONTRACT CLAUSE, ACCIDENT PREVENTION, FAR 52.236-13.

CONTRACT CLAUSE, BUY AMERICAN ACT -- CONSTRUCTION MATERIALS,
FAR 52.225-5 AND 52.225-15.

CONTRACT CLAUSE, DEFAULT (FIXED-PRICE CONSTRUCTION)
FAR 52.249-10.

CONTRACT CLAUSE, INSPECTION OF CONSTRUCTION, FAR 52.246-12.

CONTRACT CLAUSE, MATERIAL & WORKMANSHIP, FAR 52.236-5.

CONTRACT CLAUSE, PRECONSTRUCTION CONFERENCE, FAR 52.236-26.

CONTRACT CLAUSE, SITE INVESTIGATION & CONDITIONS AFFECTING
THE WORK, FAR 52.236-3.

CONTRACT CLAUSE, SPECIFICATIONS & DRAWINGS FOR
CONSTRUCTION, FAR 52.236-21.

CONTRACT CLAUSE, SUPERINTENDENCE BY THE CONTRACTOR,
FAR 52.236-6.

CONTRACT CLAUSE, VE -- CONSTRUCTION, FAR 52.248-3.

CEGS 01300, SUBMITTAL PROCEDURES.

CEGS 01440, CONTRACTOR QUALITY CONTROL.

EM 385-1-1, SAFETY AND HEALTH REQUIREMENTS MANUAL.

EP 11-1-4, VE BENEFITS & THE CONSTRUCTION CONTRACTOR.

EP 415-1-261, QUALITY ASSURANCE REPRESENTATIVE'S GUIDE.

EP 715-1-2, A GUIDE TO EFFECTIVE CONTRACTOR QUALITY CONTROL.

ER 1180-1-6, CONSTRUCTION QUALITY MANAGEMENT.

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Unless otherwise noted, the words, "he, him, or his" refer to both men and women.

All forms used in this guide were current as of January 1997. Students should update their guides with the latest forms as they become available.

FOREWORD

This training package has been developed to help familiarize contractor personnel with the Corps of Engineers Construction Quality Management concepts and procedures.

This guide was designed to be used as a workbook during the training program. It is intended that, after the training, it be included in your office bookshelf as a helpful tool to be used when needed. Updated material may be issued as necessary as errata sheets.

Questions pertaining to interpretation and explanation of this guide and suggestions for revisions and improvements should be forwarded to:

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USACE Professional Development
Support Center
ATTN: CEHR-P-DL
P.O. Box 1600
Huntsville, AL 35807-4301

Module 1: INTRODUCTION

Submodule 1: What is Construction Quality Management?

Objectives: After completing this submodule, you will be able to:

- State the purpose of Construction Quality Management (CQM).
- Discuss the reasoning behind the Corps policy on CQM.
- Discuss various characteristics that are peculiar to the construction industry.
- Define Contractor Quality Control (CQC).

- A. Introduction and Instructional Procedures: This training is presented as a result of partnering efforts with the Associated Builders and Contractors (ABC), Associated General Contractors (AGC), and the U.S. Army Corps of Engineers. This is appropriate as Construction Quality Management is a partnering effort between the government and the contractor. The purpose of this training is to familiarize all quality management personnel with Construction Quality Management policies, requirements, and procedures. In addition to the filmed portions, this training package includes this Study Guide and pertinent classroom exercises provided by your Facilitator. As we proceed through the training, the broader and more general portions of the information will be presented on video tape. At the end of each segment (module or submodule), the Facilitator will stop the tape and give you any necessary detailed information. Then, you should read the text for that submodule and proceed to the related discussions and exercise.
- B. Instructional Content: The content of this training package will include, in Module 1, an introduction covering the broad aspects of CQM, including its definition; discussions of quality control procedures and benefits; the characteristics of the construction industry and the responsibilities of the government and the contractor. In Modules 2 through 6, the various reviews, plans, conferences, reports, and management requirements are described. In Module 7, the information in the first six modules will be integrated into a discussion of the ways and means of making the CQM system work effectively so that the level of quality required in the Corps' worldwide construction program is achieved. An optional module, Module 8, is an overview of the Resident Management System (RMS). RMS is a software package that automates and simplifies many project activities.

- C. References: For acronyms see Reference/Glossary. The following is a list of references applicable to this course:

CONTRACT CLAUSE, ACCIDENT PREVENTION, FAR 52.236-13.

CONTRACT CLAUSE, BUY AMERICAN ACT -- CONSTRUCTION MATERIALS, FAR 52.225-5 AND 52.225-15.

CONTRACT CLAUSE, DEFAULT (FIXED-PRICE CONSTRUCTION), FAR 52.249-10.

CONTRACT CLAUSE, INSPECTION OF CONSTRUCTION, FAR 52.246-12.

CONTRACT CLAUSE, MATERIAL & WORKMANSHIP, FAR 52.236-5.

CONTRACT CLAUSE, PRECONSTRUCTION CONFERENCE, FAR 52.236-26.

CONTRACT CLAUSE, SITE INVESTIGATION & CONDITIONS AFFECTING THE WORK, FAR 52.236-3.

CONTRACT CLAUSE, SPECIFICATIONS & DRAWINGS FOR CONSTRUCTION, FAR 52.236-21.

CONTRACT CLAUSE, SUPERINTENDENCE BY THE CONTRACTOR, FAR 52.236-6.

CONTRACT CLAUSE, VE -- CONSTRUCTION, FAR 52.248-3.

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ER 1180-1-6, CONSTRUCTION QUALITY MANAGEMENT.

- D. History of Construction Quality Management: In 1961 a new clause containing but two sentences began appearing in Department of Defense (DoD) solicitations. These same two sentences can still be found today in the Contract Clause entitled "Inspection of Construction" [subparagraph (b)]. These sentences require a contractor to be responsible for achieving

and documenting contract quality. By 1968 the Construction Quality Management system had grown into a fairly structured process, in which more paragraphs were placed into the contract defining specific items that were to be accomplished to better manage the task. Most often, in these early years, there were a wide variety of responses on how to manage quality into the job. The Corps was faced with something of a balancing act. The contractor was either given great latitude in how he organized the effort to get quality or given specific expectations and processes. Over the years, the Corps has tried many variations and made some very specific choices. With the involvement of industry representatives, including the AGC, it was recognized that the relatively structured method used today was the preferred contract method. The system has some very specific processes. These include the three-phase inspection system, formal deficiency tracking systems, well-defined shop drawing submissions, etc. On many jobs, the Corps specifies the contractor's manpower quantity and qualifications. And, of course, this training for contractor personnel is now a contract requirement. Keep in mind that these choices are not free -- there is a cost for them and by putting them into the job, the Corps has made a choice from a spectrum of possibilities. By entering into a Corps' contract, the contractor has agreed to follow the chosen methods.

- E. Construction Quality Management: CQM is the performance of tasks which ensure that construction is performed according to plans and specifications, on time, and within a defined budget. For purposes of this training, quality is defined as conformance to properly developed requirements. For a construction project, quality begins with requirements carefully developed, reviewed for adherence to existing guidance, and ultimately reflected in criteria and design documents which accurately address these needs. Therefore, the designer establishes the quality standards. The contractor, in building to the quality standards in the plans and specifications, controls the quality of the work. The government's efforts, separate from, but in coordination and cooperation with the contractor, assures that the quality set by the plans and specifications is achieved and is thereby the purpose of CQM. In spite of government quality assurance activities the contractor has primary responsibility for producing construction through compliance with plans, specifications, and accepted standards of the industry.
- F. Contractor Quality Control: The primary function of contractor quality control (CQC) is the successful execution of a realistic plan. This CQC plan must ensure that the required standards of quality construction are met. The contract defines the procedures to manage and control his own,

all subcontractors and all suppliers' activities so that the completed project complies with contract requirements. At the end of this submodule is a list (Table 1.1-1) entitled Components of CQC.

- G. Government Quality Assurance: Quality Assurance (QA) involves the means by which the government protects its interests. Through reviews, inspections, and tests, the government assures that CQC is working effectively, and that the end product complies with the quality established by the contract.
- H. The Corps' CQM System: (Engineer Regulation) ER 1180-1-6 and other references provide guidance to Corps personnel in performing effective CQM in the field. While this regulation provides minimum requirements, each project must be tailored to suit its specific conditions and requirements.
- I. The Benefits of CQM: Both the contractor and the government must be interested in effective CQM. The benefits to the government are many, but can be summarized as "Getting our money's worth!" The benefits to the contractor are satisfactory performance, profit, better communication, planning, and increased production.
- J. Characteristics of the Construction Industry:
 - 1. The construction industry has become highly specialized because of the changing market. Increased technology and regulation have resulted in increasing numbers of specialty contractors (such as general building, heavy construction, and special trade contractors) that make coordination and management more difficult for the general contractor and complicates both CQC and QA.
 - 2. Whether large or small, specialized or general, success for all contractors is based on their ability to:
 - manage personnel,
 - control costs,
 - finance work,
 - estimate jobs,
 - schedule the work,

- manage cash flow,
 - manage an effective safety program, and
 - maintain an effective quality control system.
3. Over 80% of all construction companies are small firms that gross less than \$500,000 annually. For every 1,000 firms in operation, 110 to 130 firms enter the field each year. A similar number leave the field each year. It is a fact that the rates of entry and failure are among the highest of all industries.
 4. Construction projects are difficult to manage because:
 - construction projects are unique by nature, making standardization difficult,
 - construction operations involve many skills that are nonrepetitive and do not lend themselves to an assembly line approach, and
 - construction projects are, to a large degree, dependent upon environmental conditions which are beyond the contractor's control.
 5. For the contractor, adequate technical performance is not sufficient to ensure profit. There simply is too much competition and too little profit. The typical gross profit on a commercial building project is 5%. After deducting home office overhead, the before tax gross profit is reduced to 2-3%. After taxes, the net profit percentage is minuscule. Construction contracting is a very high risk, volatile business. To run a successful and profitable business, contractors must employ effective management.

K. In The Future:

1. New government regulations will impose more restrictive requirements, especially in the areas of environmental concerns, occupational health and safety, and employment.
2. There will be a greater degree of influence from the customer, to include their involvement in project design and construction, and the requirement to assure full documentation and timely response to all comments from them.

3. Four things that will be of significant benefit to both the government and the contractor are:
 - the emergence of improved quality control,
 - construction-oriented management information systems, such as the Corps' Resident Management System (RMS),
 - formal partnering will become more common, and
 - there will be increased contractual requirements for data automation, such as drawings on Computer Aided Drafting and Design (CADD) as-built drawings, reporting, scheduling, and electronic bid documents.
 4. Conversion to metric units and metric size components will require careful coordination, and
 5. International Competition will introduce ISO 9000 series standards of quality management on an important sector of our industry.
- L. Conclusion: The construction industry will continue to present complex, difficult challenges. To face the increasing challenges we must have the best tools, properly utilized. Even with a sound system structure, CQM requires the combined efforts of QC personnel and QA personnel to achieve our shared goals -- safe, quality construction built on time and within budget. The traditional adversarial roles of government versus contractor must be abandoned in favor of success through joint implementation of an effective quality management system. The CQM system presented here will, with our joint efforts, always be successful in providing desired quality at minimum cost.

EXERCISE

Submodule 1.1

1. In construction, what establishes the quality requirements?
2. What is the purpose of CQM?
3. Define CQM.
4. What are the two principal areas of CQM activity? Define each.

5. What are the benefits of CQM to the contractor? To the government?
6. What two factors have caused the construction industry to become highly specialized?
7. Why are construction projects difficult to manage?
8. What factors will influence both the government and the construction industry in the future?

Table 1.1-1

Components of CQC

Quality Control (QC) Plan
Preconstruction Conference
Coordination Meeting
Quality Control (QC) Reports
Submittals
Offsite Fabrication, Testing and Inspection
Material Receipt and Check-Out
Preparatory Control Phase
Initial Control Phase
Follow-up Control Phase
Deficiency Tracking
Control Testing
System Testing
Punch-out Inspection
Pre-final Inspection
Final Acceptance Inspection

Module 1: INTRODUCTION

Submodule 2: Contractor Quality Control

Objectives: After completing this submodule, you will be able to:

- Differentiate between "inspection" and "control."
 - Describe, in general, the contractor's and the Government's responsibilities in CQM.
 - Describe the benefits of CQC to the contractor, the government, and the customer.
- A. **Misunderstood System:** CQC has been one of the most misunderstood systems ever implemented by the Corps of Engineers. Some misunderstanding of the system persists even today. Originally, the misunderstanding was caused by an absence of guidelines for implementing the system. The result was the development of a jumble of management methods. In addition, the Contract Clause contributed to the misunderstanding by implying that the contractor, in his quality control role, was to duplicate the government's historical inspection activities.
- B. **Control Versus Inspection:** The contractor has the contractual responsibilities to control construction quality and inspect the work. These are two distinct processes. Control is a continual system of planning future activities. Inspection is the process by which ongoing and completed work is examined. Inspection is ongoing or "after-the-fact" while control is "preventive." The objectives of control are to ensure that the contractor is adequately prepared to begin a phase of work, to eliminate deficiencies, and to follow through in accomplishing the work in accordance with the contract. The objective of inspection is to ensure that the work is accomplished in accordance with contract provisions. The control process is sometimes neglected. This course will emphasize the control aspects of the contractor's management system.
- C. **Responsibilities:** By the contract, the responsibility for quality control is vested in the contractor. Historically, the construction industry accepted a system of control in which the contracting agency or owner continually advised the contractor on what was correct, what was wrong, and what remained to be done to comply with the contract. This not only restricted contractors and burdened contracting agencies and owners, but it placed

the responsibility for control of construction quality with the contracting agency or owner. Under the Construction Quality Management system, QC responsibility now belongs with the contractor. Government QA personnel are responsible for periodically verifying that the contractor's system of quality control is working effectively and that construction complies with contract requirements. In doing this, the Corps is actually performing quality assurance, not assuming responsibility for quality control.

D. Benefits to the Contractor:

- Effective CQC will greatly reduce the largest unnecessary cost to the contractor--the tear out and replacement cost stemming from deficient workmanship and materials.
- An effective CQC program causes work to be done correctly the first time. The contractor benefits from earlier completion, reduced field overhead costs, and the ability to do a greater volume of business.
- Reduced costs result in greater profits for the contractor.
- High quality performance improves the reputation and image of the contractor.
- Since safety is an integral part of the CQC plan, the contractor benefits by experiencing less lost-time and fewer insurance claims, which result in greater profit.
- Contractor personnel take pride in delivery of a quality product. While this benefit cannot be measured quantitatively, it is a real and very important benefit.

E. Benefits to the Government:

- Manpower is more effectively used, which helps the area/resident engineer to maintain effective operations in a time of diminishing resources.
- Effective CQC results in fewer deficiencies and corrective efforts, which may lead to an earlier completion since there is a reduction in corrective work by contractor forces.

- Public relations and customer satisfaction are improved when projects are completed on time.
 - As with contractor personnel, Corps' personnel take pride in the delivery of a quality product.
 - Cost and time growth are minimized.
- F. Benefits to the Customer: The customer's benefits of effective CQC can be simply stated--a quality product delivered safely, on time, and within the budget.
- G. Presenting the Program: It is the responsibility of both the government and the contractor to develop and promote the CQC program. This effort in "partnering" will be a much more pleasant experience than the traditional use of enforcement to ensure that a quality product is delivered.

EXERCISE

Submodule 1.2

1. What factors have contributed to the misunderstanding of CQC?
2. What is the difference between INSPECTION and CONTROL?
3. Who has contractual responsibility for quality control?
4. Is the following statement TRUE or FALSE: "CQC is principally concerned with inspection?" Explain.

5. How does the contractor benefit from effective CQC?

6. Name the benefits of effective CQC that accrue to the government.

Module 1: INTRODUCTION

Submodule 3: Contractor and Government Responsibilities

Objectives: After completing this submodule, you will be able to:

- Discuss the specific responsibilities of:
 - Contractor personnel engaged in CQC.
 - Government personnel engaged in QA.
- Discuss how the responsibilities of contractor and government personnel interrelate and are mutually supportive.
- Discuss partnering relationships.

A. **Quality Control Personnel:** As stated previously, CQC is a contractor responsibility. This includes:

- Producing the quality specified in the plans and specifications,
- Developing and maintaining an effective CQC system,
- Performance of all control activities and tests, and
- Preparation of acceptable documentation of CQC activities.

The contractor also is required to place a competent representative onsite to oversee the CQC system. He must have full authority to act for the contractor on CQC matters.

B. **The Government:** The role and responsibilities of the contractor in CQC are clearly specified in the contract documents. While the same is not true for government QA personnel, their role and responsibilities are nonetheless distinct. They require the specified standard of workmanship with the specified materials and within the limits of the contract. Further, they must require the contractor to maintain the quality specified in the plans and specifications from the very beginning. Remember, if the end product does not satisfy contract requirements, the customer and the taxpayer, are not getting their monies worth.

Another responsibility of QA personnel is to conduct onsite business only with authorized contractor representatives. They should not normally deal directly with subcontractors and individual craftsmen, but should coordinate through the prime contractor.

QA personnel are trained to advise the contractor and document any deficiencies that they discover.

- C. Communications: Most contractors want to build a quality product within the terms of the contract as they perceive them. However, it is critical that the contractor and the government interpret the plans and specifications in the same way. This requires clear and effective communication between government and contractor. This is the very heart of the Construction Quality Management program, and is dependent on mutual cooperation. QA personnel must maintain an honest, candid, professional attitude; the contractor must respond in the same manner.
- D. Partnering: Partnering is a long-term commitment between two or more organizations for the purpose of achieving specific business objectives by maximizing the effectiveness of each participant's resources. Partnering relationships are based upon trust, dedication to common goals, and an understanding of each others individual expectations and values.

Partnering is not a legally binding relationship. Rather it is a commitment and agreement between the parties to:

- Remove organizational impediments to open communication within the team.
- Provide open and complete access to information (except information specifically excluded by law, regulation, or ethical requirements).
- Empower the working level staff to resolve as many issues as possible.
- Reach decisions by consensus as much as possible and when consensus is not possible, achieve resolution in a timely manner using an agreed upon process for resolving disagreements.
- Take joint responsibility for maintaining and nurturing the partnering relationship.

Partnering should not be interpreted as a means to open the door to the compromise of contract requirements established in the plans and specifications. The quality of the project is established by those requirements and the contractor is bound to provide the level of quality specified.

Partnering is entered into either formally or informally. A formally partnered job requires a trained facilitator whose cost is shared between the government and the contractor. Informally partnered jobs are those where there is no independent facilitator, but the parties meet using a mutually determined agenda and agreement on goals and procedures is informally reached. In either case, a written partnering charter is developed and signed by all stakeholders. The final result is the development of trust and effective communications.

- E. Summary: Effective Construction Quality Management requires the complete cooperation of the contractor and the government. When this partnership works effectively, the project will run smoothly and efficiently. The contractor improves his profit margin and the end product will satisfy the customer.

EXERCISE

Submodule 1.3

1. What are the QC responsibilities of the contractor?
2. What are the responsibilities of the contractor's onsite representative?
3. What are the QA responsibilities of the government?
4. Name the items upon which a partnering relationship are based.

Module 2: CONTRACTOR'S REVIEW

Objectives: After completing this module, you will be able to:

- State the contractor's responsibilities for reviewing contract plans.
- Describe the benefit of proper layout drawings.
- State the importance of requesting clarifications from the government.
- Discuss the need for review of design extensions, designs for design-build projects, and designs for value engineering change proposals.

A. Review Plans and Specifications: Contract clause, "Specifications and Drawings for Construction," requires the contractor to review plans and specifications and request clarification where necessary. The term "Request for Information (RFI)" and other similar terms are often used to ask for clarification of the contract. Examples of items that CQC personnel shall review are as follows:

- Site conditions and restraints: Check for proper utility interface with existing facilities. Verify location of utilities in the facility, waste disposal, site location, site survey control point, etc.
- Proper allowance for maintenance space and access: The contractor is required by the contract to prepare layout drawings of equipment to assure that adequate maintenance access has been provided. The importance of the CQC participation and assurance of compliance with this requirement is critical to proper coordination. This will avoid many potentially costly conflicts.
- Conflicts and discrepancies between plans and specifications.

These examples are not meant to be all inclusive but merely to point out the type of situations that can lead to added costs to both the contractor and the government if proper reviews are not performed by CQC personnel.

B. RFI Process: The contractor should include procedures in the QC plan for a RFI process. Each RFI may be handled by separate letter, by pre-printed forms, or on the daily QC report, as mutually agreed. The questions should

be specific and clearly presented. The answers should be documented as mutually agreed. When the contractor notes a discrepancy, a recommended solution should be included with the RFI.

- C. Contractor Furnished Designs: In addition to the need for coordination review of government furnished plans and specifications, the QC must review contractor furnished designs.

Examples are:

- Design-Build: In this type of contract, the contractor's QC efforts must include design quality control. The QC plan must include details of reviews to be implemented to ensure that the design will comply with the criteria provided.
 - Extensions of Design: Many contracts contain requirements for the contractor to provide designs such as pre-engineered metal buildings, fire alarm and protection systems, cathodic protection, etc. It becomes critical that the contractor designs are coordinated with all other aspects of the project so that proper interfaces are maintained. Where extensions of the design are required (structural steel details, concrete reinforcement drawings, etc.) by the contractor, subcontractors, or suppliers they must be coordinated with other activities. This coordination review is performed with other contractually required submittal reviews.
- D. Value Engineering Change Proposal (VECP): The CQC should review any VECP to assure proper coordination with all affected elements of the project. After acceptance of the VECP, CQC must ensure that changes are discussed in the control meetings for all other applicable work to assure full benefit of the savings is achieved.

EXERCISE

Module 2

1. Name three instances of contractor extensions of designs.

2. Name some possible areas that must be addressed during the contractor's coordination review of plans and specifications.

3. The following (3A through 3F) are extracts from specifications and drawings for a recent designed project. They all contain errors, omissions, or inconsistencies that were discovered during the review. Examine the "highlighted" area(s) of each, and indicate what clarification is needed.

Exercise	Clarification Needed
----------	----------------------

3A	
----	--

3B

3C

3D

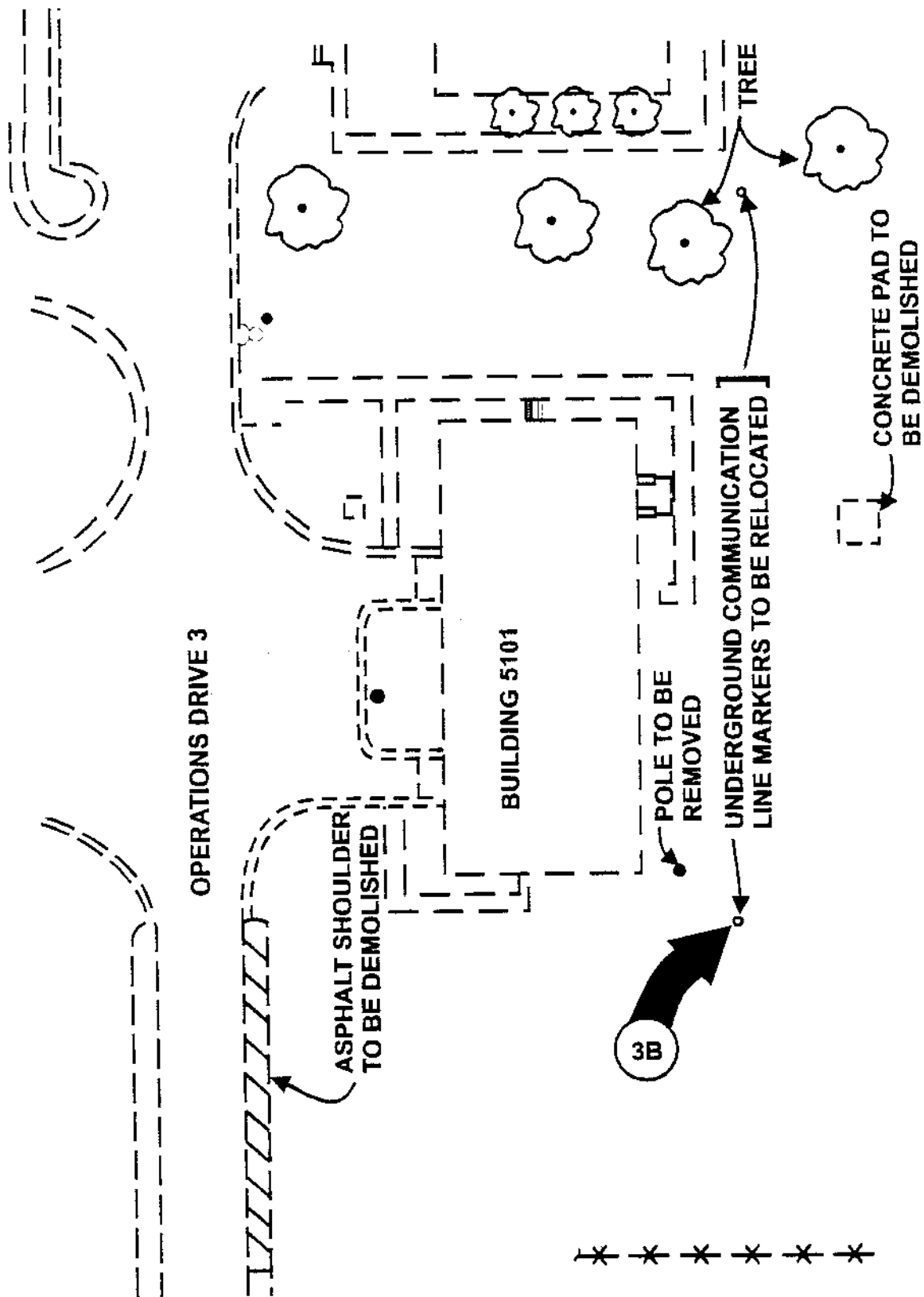
3E

3F

The diagram is a site plan showing the layout of Building 5101 and its surroundings. Key features and annotations include:

- Operations Drive 3:** A road on the left side of the plan, indicated by a dashed line with a hatched shoulder.
- Building 5101:** A large rectangular structure with internal room divisions, located in the center-right.
- Demolition and Relocation Markers:**
 - A dashed line with an arrow pointing to the road shoulder is labeled "ASPHALT SHOULDER TO BE DEMOLISHED".
 - A dashed line with an arrow pointing to a pole is labeled "POLE TO BE REMOVED".
 - A dashed line with an arrow pointing to a tree is labeled "TREE".
 - A dashed line with an arrow pointing to a concrete pad is labeled "CONCRETE PAD TO BE DEMOLISHED".
 - A dashed line with an arrow pointing to a communication line is labeled "UNDERGROUND COMMUNICATION LINE MARKERS TO BE RELOCATED".
- Other Features:**
 - A circular feature labeled "3A" is located near the bottom center.
 - A series of asterisks (*) is located at the bottom of the plan.

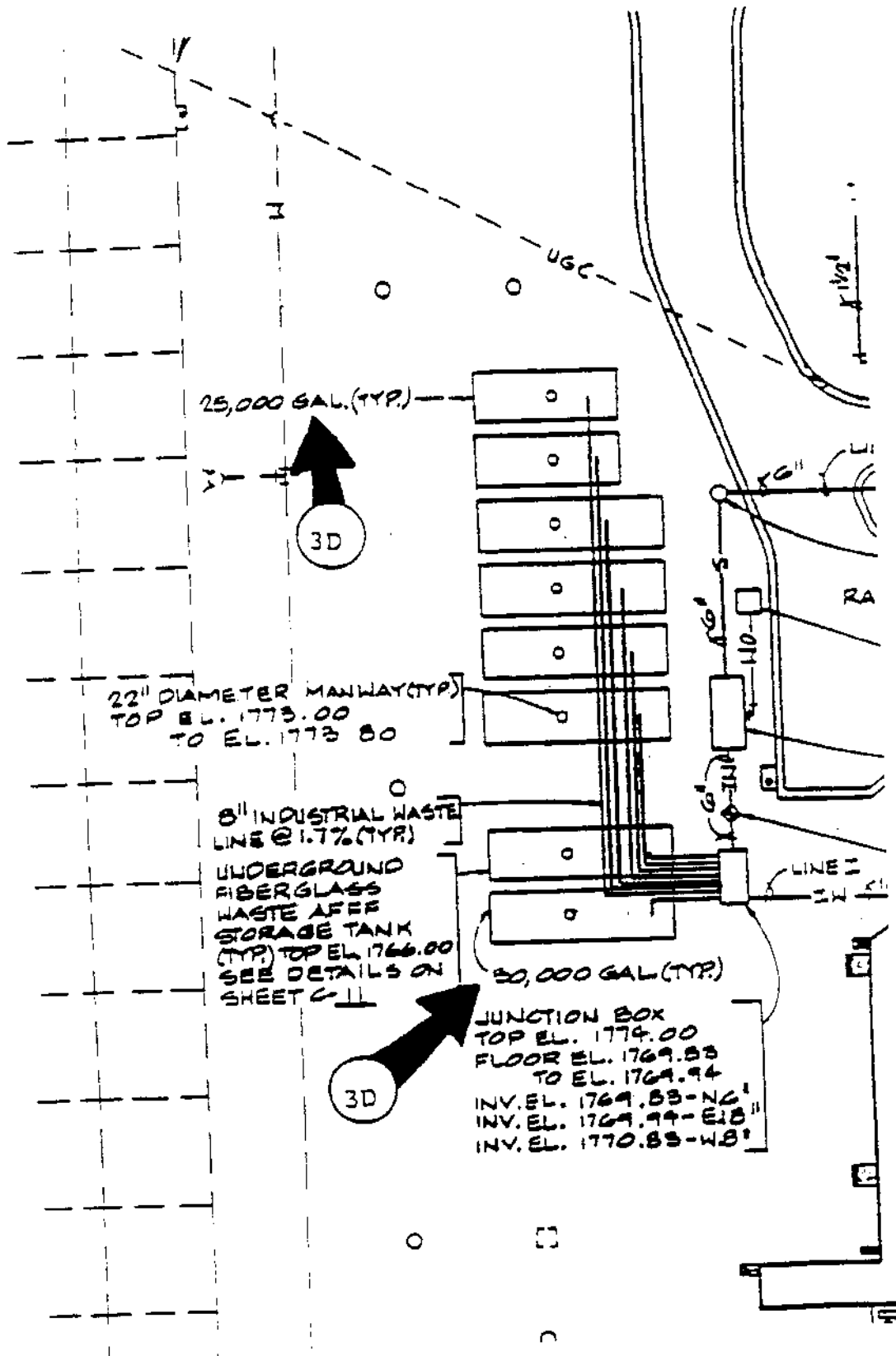
EXERCISE QUESTION 3B:



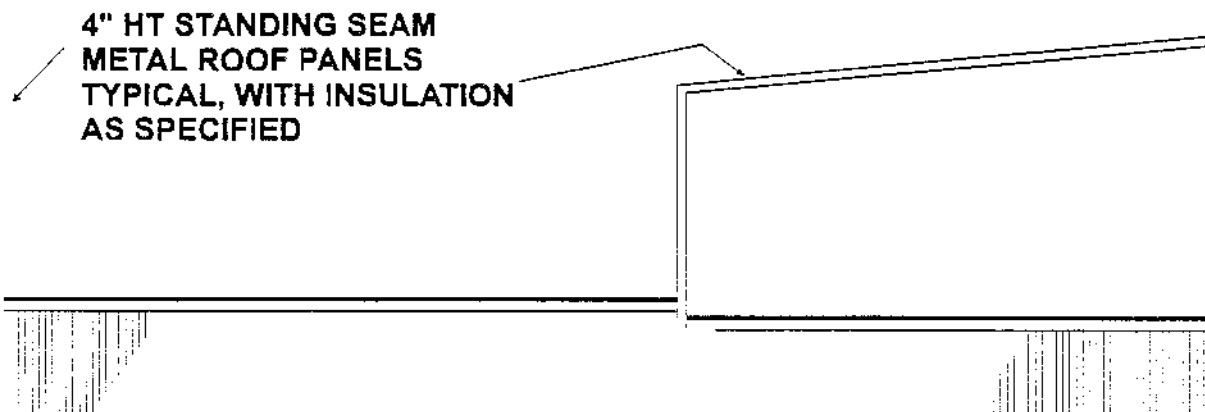
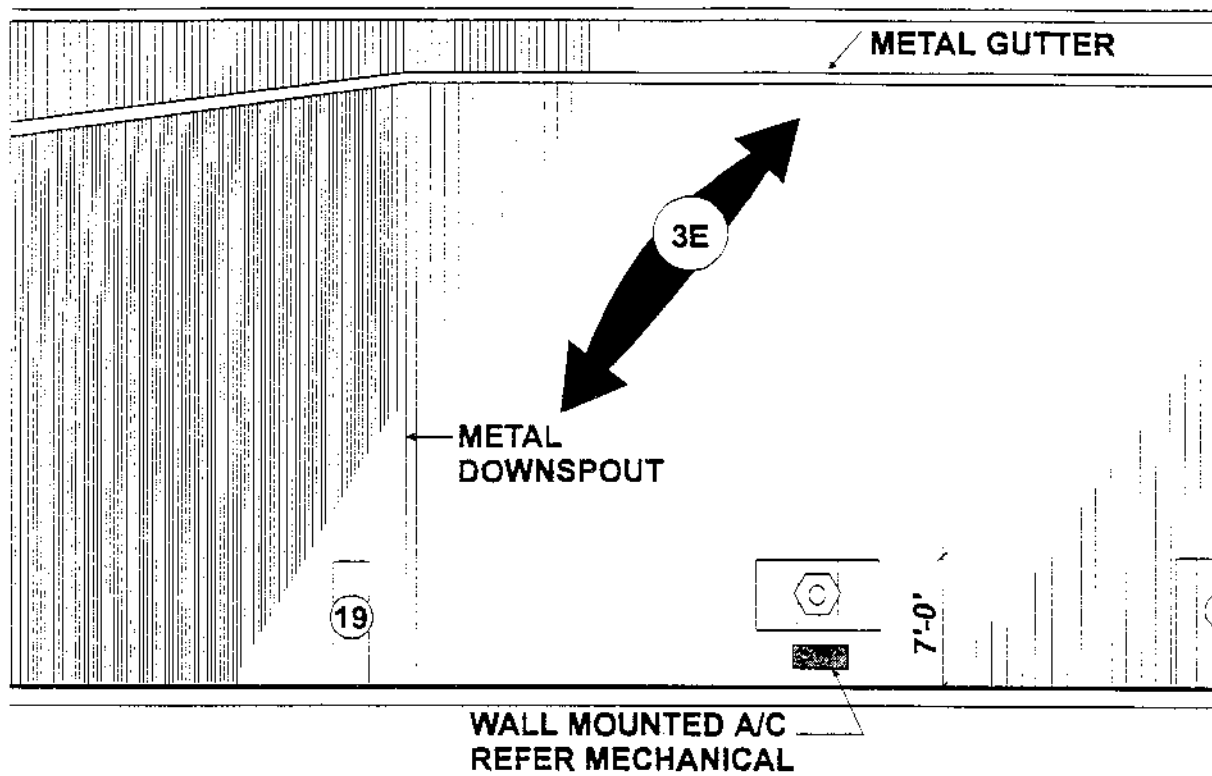
The diagram is a site plan for Building 5101. It shows the building's footprint with various rooms and corridors. Key features and annotations include:

- Operations Drive 3:** A road on the left side of the building.
- Asphalt Shoulder to be Demolished:** Indicated by a hatched area along the road.
- Pole to be Removed:** A small structure near the road.
- Underground Communication Line Markers to be Relocated:** Indicated by a dashed line with arrows pointing to specific locations.
- Concrete Pad to be Demolished:** A rectangular area near the road.
- Tree:** A large tree on the right side of the building.
- Building 5101:** The main structure, with various rooms and corridors labeled.
- Legend:** A circle with the number 30 and an arrow pointing to the concrete pad.

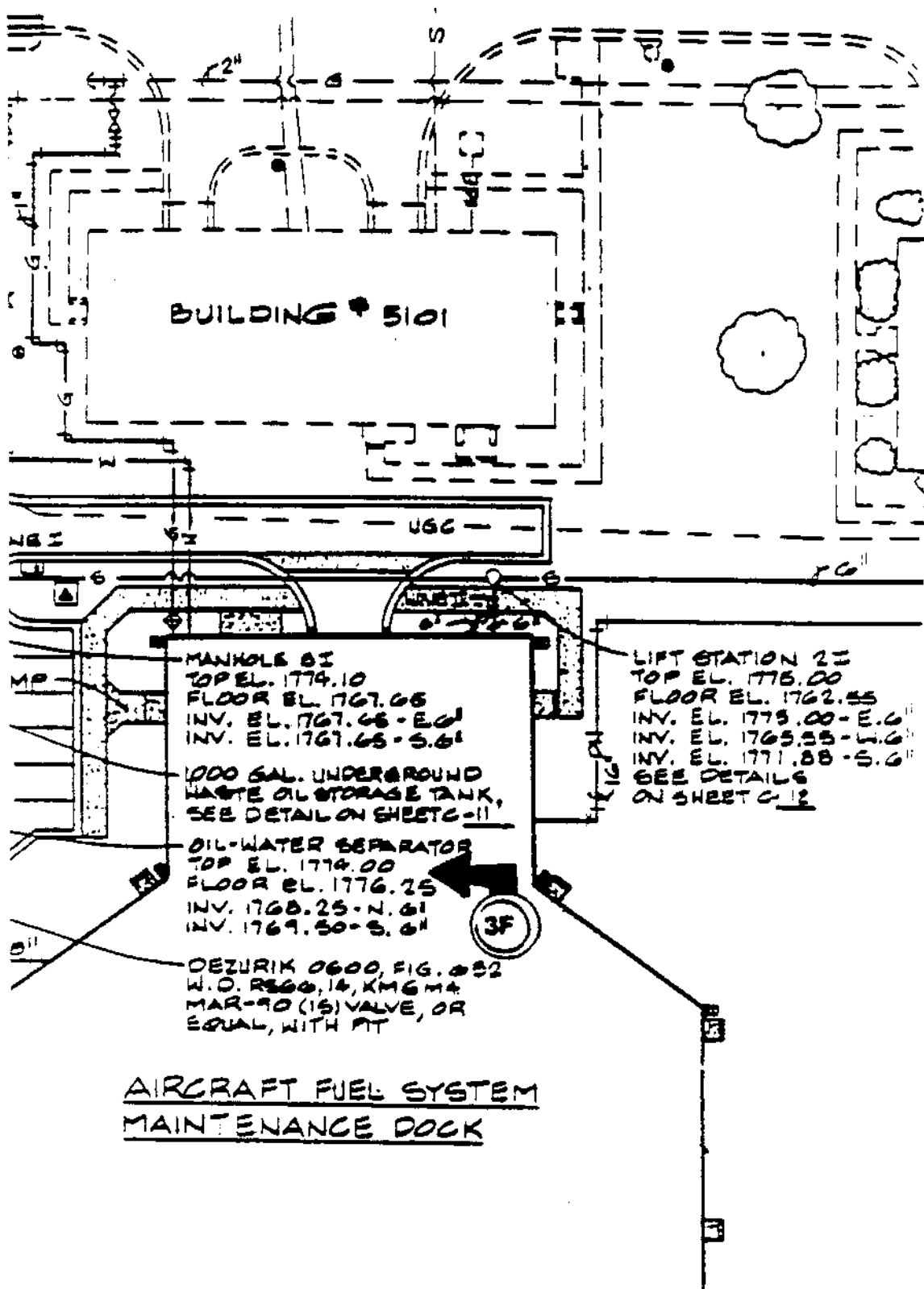
EXERCISE QUESTION 3D:



EXERCISE QUESTION 3E:



EXERCISE QUESTION 3F:



Module 3: QUALITY MANAGEMENT PLANNING

Submodule 1: Purpose and Components

Objectives: After completing this submodule, you will be able to:

- Identify the components of a QA Plan.
- Define the Quality Control (QC) Plan.
- Identify the components of the QC Plan.

A. The Quality Assurance Plan:

1. The QA Plan is a government document used as a management tool. It is required by ER 1180-1-6. It is not a contract requirement. The components of a QA Plan are:
 - Government staffing requirements.
 - Functions of each QA team member.
 - Government training requirements.
 - Government pre-award activities.
 - Government surveillance and testing activities.
2. The QA Plan ensures that all team members are following the same plan and achieves better coordination of the government's QA activities. Just as important, the contractor will be receiving consistent guidance and will be able to respond to requirements in a more effective manner. For construction quality management to be effective, quality control and quality assurance must be coordinated and compliment one another. Area/resident engineers require quality assurance personnel to become fully aware of the QA Plan as well as the CQC requirements. Based upon this knowledge, the groundwork is established for **government/contractor partnership**.

B. The Quality Control Plan:

- The Contractor's QC Plan is the foundation upon which quality work is based. It is an outline of the planned quality control procedures, and is vital to the quality control system. The plan must be comprehensive, detailed, and logical if the contractor's quality control system is to be effective. While experience and knowledge of the construction industry are necessary in developing a good QC Plan, the contractor must consider fully the specific contract requirements and special factors peculiar to a project as well.
- The QC Plan must be received, reviewed, and formally accepted before any construction begins. In some cases, this requirement can be met by an interim plan. This first submission by the contractor must include, as a minimum, his general plan for quality control, plus the specifics for the work he is about to begin. A final acceptable plan must be received within a reasonable time. The contractual requirements are found in Section 01440 of the contract.
- Resident Management System (RMS) is a Corps' data management system that provides an easy mechanism for developing a QC Plan based on contractor input. RMS is discussed in detail in optional Module 8.

C. Quality Control Plan Components:

- The QC organization must be identified, including a chart showing lines of authority. The contractor must provide sufficient quality control personnel to satisfy all contract requirements. The contractor's quality control staff may vary in size, depending on the work being performed at a point in time. The personnel of this staff shall be fully qualified by experience and technical training to perform their assigned duties. In any case, the contractor must indicate how he intends the staff to meet all requirements. This assures that the contractor has identified needs in advance, is planning to satisfy those needs, and is not overlooking or underestimating requirements.
- Qualifications of individual quality control personnel must be addressed. This includes subcontractors and supplier personnel assigned QC duties. The name, classification and qualifications of each member of the contractor's quality control team must be submitted, together with assigned individual duties, responsibilities and authorities. This information may be provided in phases, as work progresses; however,

the government must receive the information before an individual begins work.

- The plan must include a list of the definable features of work. A definable feature of work is a task which is separate and distinct from other tasks and has separate control requirements. As a minimum, each section of the specifications shall be considered as a definable feature. However, there may be more than one definable feature under a section of the specifications, masonry, landscape, plumbing, interior electrical, etc.
- The plan must include procedures for scheduling and managing submittals, including those of subcontractors, offsite fabricators, suppliers, and purchasing agents.
- The plan is the means by which the contractor assures himself that his construction, to include his subcontractors and suppliers, complies with the requirements of the contract plans and specifications. The controls shall be adequate to cover all construction operations, including both onsite and offsite fabrication, and will be keyed to the proposed construction sequence. The core of the Quality Management system in the Corps of Engineers is the Three Phase Control system. The controls shall include at least three phases for all definable features of work, as follows:
 - Preparatory Phase. This phase shall be performed **prior to beginning** work on each definable feature of work.
 - Initial Phase. This phase must be accomplished **at the beginning** of a definable feature of work.
 - Follow-Up Phase. Daily checks shall be performed to assure continuing compliance with contract requirements.
- The plan must contain assigned quality control activities for performance by the prime contractor, subcontractor(s), offsite fabricators, and suppliers. Further, if the contractor delegates certain quality control duties, the plan must indicate how he will assure the effectiveness of the quality control efforts of the subcontractor(s), offsite fabricators, or suppliers.
- Performance of control testing is to be included in the plan. If technicians employed by the contractor will be performing the tests, the

plan must indicate who will perform specific tests and their qualifications. If a commercial laboratory is to be used, the plan must indicate both the laboratory to be used and the test methods to be employed.

- Specifics relative to test report submissions are to be addressed in the QC plan, including format, content, and consistency of all documentation.
- The plan contains procedures to be followed in giving advance notice to the government of the times when tests will be conducted.
- The contractor must assign a single onsite representative for quality control, just as the government did for quality assurance. The QC Plan must contain a letter of direction to the contractor's quality control onsite representative specifying his duties, responsibilities, and authorities, signed by a responsible officer of the contractor's firm.
- The plan must contain procedures for tracking construction deficiencies from identification through corrective action.
- The plan must include provisions for the CQC representative to conduct completion inspections of the work and develop a "punch list" of items which do not conform to the contract requirements. The CQC representative shall make a second completion inspection to ascertain that all deficiencies have been corrected and so notify the government. The completion inspections and any deficiency corrections will be accomplished within the time stated for completion of the work.
- The plan must include documentation procedures including proposed reporting format.
- The plan must include project completion turnover procedures. These may include:
 - punch-out
 - pre-final to include the government
 - final inspection to include the customer
 - "punch list"
 - deficiency correction and verification
 - final system testing
 - system operation and sequence verification
 - O & M manuals
 - instruction and training procedures

- completed as-built drawings
- turnover of keys
- turnover of extra materials and spare parts
- warranty information.

D. References: Specific QC requirements are found in the construction contract. Although not part of the construction contract, a primary reference on the QC Plan is (Engineer Pamphlet) EP 715-1-2, "A Guide to Effective Contractor Quality Control." This pamphlet is an excellent source of information--it is concise and to the point, indicating the areas to be addressed in developing an effective, well-planned contractor quality control system. It is a valuable aid for both government and contractor personnel in understanding quality control.

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Module 3: QUALITY MANAGEMENT PLANNING

Submodule 2: Review and Acceptance

Objectives: After completing this submodule, you will be able to:

- Describe the process used to review the contractor's Quality Control (QC) Plan by comparing it to the requirements of the contract provisions and determining its feasibility.
 - State the basic concepts which the government uses to accept or return a QC Plan.
- A. Quality Control Plan Review Participants: There are three individuals who are normally involved in the review of the CQC Plan, they are the area/resident engineer, the project engineer, and the onsite QA personnel.
- B. Two Major Steps in the Review Process:
- Examination of the QC Plan in light of the requirements of the specifications.
 - Determination of the QC Plan's feasibility. This requires the reviewers to have a good working knowledge of contract requirements.

If problems are discovered, it is necessary to identify those points in the plan that need change or clarification.

- C. Assure Minimum Requirements Are Met:
- Determine that the plan provides adequate control of the definable features of work.
 - Examine the proposed QC staffing and organization to ascertain if it complies with contract specifications. Determine if the contractor has provided the names and qualifications (in resume format) of the individual(s) responsible for QC of each definable feature of work, tests, submittal controls, and reports.
 - Check that the level of authority and responsibility delegated to the contractor's QC representative is clearly defined.

- Assure that the QC Plan:
 - clearly assigns individual control and test duties,
 - defines the capacity in which individuals will be working, and
 - indicates what tests will be used.
 - Determine that the plan addresses the procedures for processing submittals.
 - Check that the plan specifies which contractor (prime, subcontractor, offsite fabricator, or supplier) will be performing what portions of QC.
 - Assure that report forms include required features and reporting items.
- D. Acceptance of the QC Plan: If the initial review reveals that changes are necessary, the changes must be made by the contractor before the plan can be accepted. Acceptance of the plan is based on satisfactory QC performance once construction is underway. The government always reserves the right to require necessary changes in the QC Plan and in contractor operations so as to obtain the specified quality. After the plan has been accepted, if some part of the plan isn't working, the government may require changes to be made.
- E. Commencement of Construction: Until an interim or final QC Plan is accepted, construction cannot begin.
- F. Changes to the QC Plan: If the contractor wants to make changes in the QC Plan during construction, the government must be notified in writing. The contractor cannot implement any change until the government has formally accepted the changes in writing. If deficiencies are occurring, the plan needs to be studied to see if the problem is nonadherence or if revisions should be made to correct shortcomings in the QC Plan.
- G. Distribution: After the QC Plan has been reviewed, changed as necessary, and accepted, copies are distributed to all personnel involved in QC activities. The government provides copies to onsite QA personnel.
- H. Example Quality Control Plan: An example of a QC plan is provided in the exercise section of this submodule. Included with the plan is: a letter of transmittal from the contractor to the Area Engineer.

EXERCISE AND EXAMPLE

Submodule 3.2

Following is an example of a QC Plan, but it is not complete. Review this plan and comment on how it could be improved to meet the contract requirements.

**Keyes Construction Co., Inc.
General Contractor
5318 Madison St.
Denver, Co 80200**

May 19, 19xx

Serial No. MC-4

**Area Engineer
U.S. Army Corps of Engineers
563 W. Granger
Colorado Springs, CO 80900**

**RE: One Tactical Equipment Shop
DACA92-97-C-0111
Ft. Carson, CO**

Gentlemen:

**We are submitting, herewith, our Quality Control Plan for the above
referenced project for acceptance.**

Very truly yours,

**Warren J. Cooper
Construction Manager**

**Keyes Construction Company, Inc.
5318 W. Madison
Denver, Colorado 80200**

WC/1d

**cc: Field
File**

**QUALITY CONTROL PLAN
KEYES CONSTRUCTION COMPANY, INC.
FOR CONSTRUCTION OF
ONE TACTICAL EQUIPMENT SHOP
FORT CARSON, COLORADO
CONTRACT NO. DACA92-97-C-0111
MAY 19xx**

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8.0 DEFINABLE FEATURES OF CONSTRUCTION WORK

Keyes Construction Co., Inc.
General Contractor
5318 Madison St.
Denver, Co 80200

May 19, 19xx

Serial No. MC-5

Army Engineer
U.S. Army Corps of Engineers
563 W. Granger
Colorado Springs, CO 80900

RE: One Tactical Equipment Shop
DACA92-97-C-O111
Ft. Carson, CO.

Gentlemen:

This is to introduce Morton S. McCray for the position of Contractor's Representative for Quality Control on the above referenced project.

Very truly yours, .

Warren P. Crossen
Construction Manager

Keyes Construction Company, Inc.
5318 Madison St.
Denver, Colorado 80200

WC/1d

cc: Field
File

Keyes Construction Co., Inc.
General Contractor
5318 Madison St.
Denver Co. 80200

May 19, 19xx

Morton S. McCray
Quality Control System Manager
3636 Belview Avenue
Colorado Springs, CO 80900

RE: Quality Control
One Tactical Equipment Shop
DACA92-97-C-0111

Dear Mr. McCray:

This is a Letter of Direction to you outlining your duties and responsibility as our Quality Control Representative on the above referenced project.

You will be responsible for preparing and maintaining the Submittal Register Form 4288 for the duration of the project. You are required to check all shop drawings for accurate dimensions and to ensure compliance to applicable specifications and drawings as to the quality of materials being proposed for the project. This also applies to all subcontractors, offsite fabricators, and suppliers.

You will make, on a continuing basis, sufficient daily follow-ups to ensure that all workmanship and materials in the construction of this project are in conformance with the specifications and drawings.

You will be responsible for all testing as required by the specifications, a qualified testing laboratory will be furnished to you, as outlined in The Keyes Construction Quality Control Plan.

You will be present during all testing and coordinate all such tests as required in accordance with the specifications and the Corps of Engineers Representative.

The quality control system will include three phases of control and tests. Primarily, Preparatory Phase, Initial Phase, and Follow-up Phase. You are

directed to Section 01440, paragraph 3.6 for specific instructions outlining these control phases. All control phases and tests shall be recorded daily on the Quality Control Report and submitted the following work day covered by the report to the government Representative. All test results shall be submitted in triplicate copies, not later than three calendar days after the tests are performed.

You are directed to review The Keyes Construction Quality Control Plan as well as the Project Specifications, Amendments and Drawings, in their entirety. If there is an item not understood, you are to consult your Quality Control Support Team.

The Quality Control Support Team will consist of the Project Superintendent and Keyes Construction Project Management.

Sincerely,

Warren P. Crossen
Construction Manager

WC/1d

cc: Field
Corps of Engineers

**QUALITY CONTROL PLAN
ONE TACTICAL EQUIPMENT SHOP
FORT CARSON, COLORADO
CONTRACT NO. DACA92-97-C-0111
MAY 19xx**

1.0 PURPOSE

This document establishes the Quality Control System of Keyes Construction Company, Inc. to provide the necessary supervision, control phases and tests of all items of work, including that of suppliers and subcontractors, that will ensure the compliance of all work with the applicable specifications and drawings in respect with the contractor-furnished equipment, materials, workmanship, construction, finish, functional performance, and identification. —

2.0 POLICY

Keyes Construction Company, Inc. through the utilization of a Quality Control System, strives to obtain a uniform, high quality level of workmanship throughout all phases of procurement, fabrication, construction and installation of equipment and facilities, to assure this end, the following principles will be observed:

- A. Assure the highest quality by maintaining supervised controls and written instructions governing quality control procedures and practices, establish clearly defined responsibility and authority for compliance.
- B. Conform to all contractual requirements, specifications, applicable military standards and the Keyes Construction Company, Inc. Quality Control Plan. Compile accurate records of test certifications and other required documentation.
- C. Notify Project Management, and the government of quality discrepancies for immediate corrective action. Assure that corrective action is implemented properly.
- D. The Quality Control System Manager will be housed in a space separate from the Project Management staff and shall be under the supervision of Keyes Construction Company, Inc. home office.

3.0 ORGANIZATION

- 3.1 Quality Control System Manager - Reports to and receives his authority directly from Keyes Construction Company, Inc. management. The Quality Control System Manager shall formulate and implement as required the written procedures and instructions contained in this plan. Actual practices are not limited to this plan and where a discrepancy exists between this plan and the contract requirements, the contract requirements shall prevail. Consults with project supervisory personnel to assure compliance with the quality control requirements of the contract. Coordinates the quality control efforts of subcontractors and suppliers to correspond with the overall Quality Control Plan. He shall provide direct feedback and advise the government representative regarding the effectiveness and capability of the quality control organization, including but not limited to coordination, field engineering, office engineering, accounting for government-furnished property, etc. He will be physically on the project site for the duration of the contract work. He will review and coordinate submittals and approvals for contractor furnished materials and equipment, conduct tests, and follow-ups of subcontractor's work as required to ensure compliance with contract plans and specifications.
- 3.2 Contractor's Other Personnel - Quality control functions will be carried out by other contractor's personnel to include the Project Superintendent who will be physically on the job-site for the duration of the contract work.

He will assist the Quality Control System Manager in other areas as required to fully implement the Quality Control Plan. The QC system manager may delegate such duties to other contractor's personnel who may be assigned to the project on a temporary basis such as Field Engineers and Superintendents.

3.3 Commercial Testing Firms

Commercial testing firms to be utilized are:

Testing Laboratory, Inc.
2003 E. Willard St.
Denver, Colorado 80900

4.0 **PROCEDURES**

- 4.1 **Control of Onsite Construction** - The Quality Control System Manager will perform sufficient control phases and tests of all work, including that of subcontractors to ensure conformance to applicable specifications and drawings with respect to the materials, workmanship, construction, finish, functional performance, and identification.

The Quality Control organization will perform at least three phases of control for all definable features of work, as follows:

- a. **Preparatory Phase** - Performed prior to beginning each definable feature of work. Notify the government and other appropriate persons at least 24 hours in advance of the meeting.
 - (1) Review contract requirements.
 - (2) Check to assure that all materials and/or equipment are on hand and have been tested, submitted, and approved as required.
 - (3) Check to assure that provisions have been made to provide required control testing.
 - (4) Examine work area to assure that all preliminary work has been accomplished.
 - (5) Review hazard analysis.
- b. **Initial Phase** - Performed at the beginning of a definable feature of work. Notify the government and other appropriate persons at least 24 hours in advance of the meeting.
 - (1) Check preliminary work.
 - (2) Check new work for compliance with contract documents.
 - (3) Review of control testing.
 - (4) Establish level of workmanship.

- (5) Check for use of defective or damaged materials.
- (6) Check for omissions and resolve any differences of interpretation with the government representative.
- (7) General check of dimensional requirements.
- (8) Check safety compliance.

c. Follow-Up Phases - Perform daily checks to assure continued compliance with workmanship established at the initial phase.

- (1) Assurance of continuous compliance with contract drawings and specifications .
- (2) Daily control testing.

4.2 Receiving and Warehousing - Inspection of permanent construction materials received will be performed by the Quality Control System Manager, or other contractor personnel. Visual inspection will be made for:

Identification

Damage

Completeness

Evidence of compliance with approvals

Proper documentation

Results of receiving inspection will be recorded on an appropriate report form and will be made available to the government.

4.3 Offsite Control - Facilities of offsite fabricators and suppliers will be surveyed as required to assure that all requirements of the contract drawings and specifications are met and maintained and to assure delivery of quality products. The results of each survey will be recorded on an appropriate form and will be made available to the government. The fabricator or supplier will be notified of any

deficiencies and will be required to submit a report of corrective actions taken. The contractor will inform the government of offsite surveys.

- 4.4 Documentation - The Quality Control System Manager will maintain current records of all control activities and tests. These will include factual evidence that the required control phases and tests have been performed, including the number and results; nature of defects, causes for rejection, etc.; proposed remedial action; corrective actions taken; contractor's records will cover both conforming and defective features and will include a statement that all supplies and materials incorporated in the work are in full compliance with the terms of the contract. Legible copies of these records on an appropriate form will be furnished to the government daily.
- 4.5 Drawing and Document Control - Contract drawing, work orders and change orders issued for construction will also be issued to the Quality Control System Manager. It is the responsibility of the Office Engineer to issue all technical information to the Quality Control System Manager. It is the responsibility of the Quality Control System Manager to maintain this technical information and keep it current and recorded as it is revised. No technical information will be replaced or revised without receipt of properly authorized change notice, revision, or equal.
- 4.6 Materials Certification - Copies of all purchase orders or subcontracts requiring receiving inspection will be given to the Quality Control Department for receiving and record purposes. When the purchase order requires vendor certification of materials, equipment, or supplies, such certification shall be verified as to accuracy and conformance and may be used in lieu of a test for those properties covered by the certification. Copies of all certifications received will be maintained in the Quality Control folder and will be available to the government upon request or submitted to him as provided in the contract specifications.
- 4.7 Workmanship Inspection - Items which will be embedded in the concrete placements or areas which will be covered up by a following operation will be inspected by the Quality Control System Manager. The Quality Control System Manager shall verify by

signature that all items installed are in accordance with the contract drawings and specifications prior to the placement of concrete or covering. Any corrective action required will be recorded.

4.8 Calibration of Equipment - All contractor furnished measuring and test equipment shall be calibrated and maintained to traceable government standards. Records of these calibration certifications will be maintained by the Quality Control Department and made available to the government upon request.

- a. Each instrument will be plainly and permanently numbered, the equipment will be operated only by those persons directly responsible for the equipment or personnel under their cognizance.
- b. Each piece of equipment will be checked for accuracy as recommended by manufacturer for frequency of calibration. Required calibration of measuring and test equipment will be conducted by a certified laboratory.
- c. Measuring and test equipment dropped, damaged, or believed to be inaccurate will be removed from services and recalibrated.

4.9 Final Inspection and Test - Prior to final inspection or start of tests, all systems being inspected or tested shall be completed and accepted by the Quality Control System Manager, after this acceptance, the final inspection and test may proceed in accordance with the following steps:

- a. Verify the test personnel have a working knowledge of the special characteristics of the instruments being used.
- b. Note the particular inspection or test requirements and criteria for successful completion of the required inspection or test.
- c. Upon satisfactory verification of these requirements the test may proceed. Each reading will be verified and documented by the Quality Control System Manager. All functional validations or tests will be performed by the Quality Control Department unless otherwise noted. No functional test will be

performed by the Quality Control Department unless otherwise noted. No functional test will be accepted without properly authorized and approved test procedures.

d. The general requirement of final acceptance will include, but not be limited to, the following:

- (1) General appearance
- (2) Workmanship
- (3) Cleanliness of areas and equipment
- (4) Identification of equipment
- (5) Painting
- (6) Removal of unused material and temporary facilities
- (7) Condition of job files and completion of paperwork

4.10 Revision Policy - Activities, programs, and procedures not covered in this Quality Control Plan or proposals or additions to these standards, shall be discussed at meetings held for that purpose at such times and places the Quality Control System Manager may select, and shall take such action to request acceptance from the government to incorporate such revisions as deemed necessary. A record shall be kept of such meetings and interested parties present, together with the subject matter reviewed. Such meetings shall be held as required by changes in the contract specifications for the purpose of reviewing the QC plan, to entertain revisions, additions or deletions. Accepted revisions shall be incorporated in the plan as first revision, second revision, etc., a revised index page shall be included.

5.1 TESTING METHODS

All testing will be in accordance with the applicable section of the specifications.

6.0 RECORDING FORMS

The contractor quality control personnel will perform all tests as indicated in the contract specifications using the appropriate Corps of Engineers ASTM, or other approved test methods. The following list itemizes some of the forms which the contractor quality control personnel intend to use. This list is not all inclusive and may be revised and updated as conditions require. The contractor's records will be available for review by the government.

- a. Subcontractor Daily QC Report - To be filled out daily by the subcontractors quality control personnel covering the day's quality control activities, approved by the Prime Contractor's Quality Control System Manager, and placed in the Prime Contractor's file.
- b. Construction Quality Control Daily Report - To be used by the Quality Control System Manager to report the day's quality control activities of the Prime Contractor and all subcontractors, submitted to the government daily.
- c. Trip Report - Used to report activities covering offsite trips. Will be submitted with the contractor's Quality Control Daily Report.

Daily QC reports and all attachments will be submitted in duplicate on the first working day following the day covered by this report.

- a. Copies of all inspection and test reports including data and calculation sheets will be submitted with the daily QC report.
- b. Quality Control System Managers' reports will contain notations specifically defining the phase of control on each day's activities and note compliance or non-compliance with previous phases when applicable.
- c. The government will be notified 24 hours in advance of all tests to be performed in the field.
- d. Concrete Placement Card - To be filled out prior to, during and after concrete placement to document that preparatory, initial and follow-up phases have been made for concrete placement. A copy of this report is to be included with the daily QC report.

- e. Concrete Summary - Provides a running summary of concrete test results. To be kept in contractor's files and made available to the government upon request.
- f. Density Test Summary - Provides a running summary of soil testing results. To be kept in contractor's files and made available to the government upon request.

7.0 QUALITY CONTROL PROCEDURES

- 7.1 Surveillance of Subcontractors' Operations - Surveillance of the subcontractors' operations is the responsibility of the Quality Control System Manager. Major discrepancies that come to his attention will be recorded and transmitted to the related subcontractor. The contractor's Quality Control System Manager has authority to act directly with subcontractor representatives on routine quality control activities. If the discrepancy is related to a concrete placement or will be covered by preceding operation, a resolution will be made prior to the item being covered. Major discrepancies will be followed up on a daily basis, upon correction of the major discrepancy, the date corrected will be noted and by whom.

There is one Quality Control System Manager for the Keyes Construction Company, Inc. with support of the Project Superintendent and Keyes Construction Company, Inc. Project Management. Surveillance of the subcontractors operations is the responsibility of the Quality Control System Manager. The Contractor's Quality Control System Manager has authority to act directly with subcontractor representatives on routine quality control activities.

In addition to the Contractor's Quality Control System Manager, the Mechanical and Electrical Contractor's Superintendent will act as their quality control engineer and will be directly responsible to the Contractor's Quality Control System Manager, and the Keyes Construction Company, Inc. Quality Control Support Team.

- 7.2 Inspection Acceptance Procedures - All construction work shall be in accordance with the contract drawings and specifications. All rework or changes which change existing engineering drawings or specifications must be authorized. All construction work will be recorded on the Quality Control System Manager's report. Work

found in compliance with the drawings and specifications will be so noted. If discrepancies are found, they will be handled in accordance with inspection discrepancy procedures.

- 7.3 Inspection Discrepancy Procedure - Intended as an inspection system whereby all discrepancies in quality, workmanship, materials, equipment, supplies, and/or unauthorized deviations from engineering requirements on specifications can be called to the attention of responsible supervision personnel.
- a. Discrepancies will be recorded on the Quality Control Daily report form. Each discrepancy will be assigned a number by the recording Quality Control System Manager. A concise statement locating the discrepancy and description of the discrepancy will be filled in by the Quality Control System Manager.
 - b. When material, equipment, supplies, or workmanship, that does not conform to the contract drawings or specifications are rejected, the rejecting Quality Control System Manager will initiate a discrepancy report and immediately furnish copies to the contractor's Project Manager and Superintendent or Subcontractor's Job Representative.
 - c. Upon reviewing the discrepancy report, the Project Manager or his representative and the Quality Control System Manager will examine the rejected items. If in their opinion, any of the rejected items can be reworked to a usable condition, the discrepancy report will be so noted. However, if, in their opinion, the item cannot be reworked either from a practical and economical standpoint, the item shall be scrapped and an entry made on the discrepancy report concluded to that effect.
 - d. Upon completion of rework on items specified for rework, the Quality Control System Manager will be notified and he will re-inspect the item(s) to the original requirement plus the rework information on the discrepancy report. If it is found acceptable, the discrepancy report will be so noted. From this point on, the item(s) will be handled in the normal manner. If, however, the item(s) is still not acceptable to the Quality Control System Manager due to poor workmanship, etc.,

arising from the rework, we will treat this item as a first time rejection and this will be resubmitted for inspection only after further rework.

- e. The discrepancy report log will be periodically reviewed by the Project Manager with the Quality Control System Manager to formulate a disposition of each listed uncorrected discrepancy. They will establish timetables for final resolution of all discrepancies.

7.4 Concrete Testing Procedures - Field testing of concrete and preparation, handling, curing, and testing of cylinders will be in accordance with ATSM and CRD Standards as set forth in paragraph 5.1.

In addition, the following ASTM Standards will be followed:

- C 173-73 Air content of freshly mixed concrete by the volumetric method.
 - C 470-73T Molds for forming concrete tests cylinders vertically.
 - C 617-73 Capping cylindrical concrete specimens.
 - C 683-71T Compressive and flexural strength of concrete under field conditions.
- a. Test cylinders will remain in the area where they are prepared for the first 24 hours properly protected as set forth in ASTM 31-69. They will then be transported to the laboratory, removed from the mold and immersed in a tank of saturated lime water until time of testing. Transportation from work area to laboratory area on the job-site will be in boxes containing wet sand or sawdust and will be protected from freezing.
 - b. Field test specimens for concrete paving shall be in accordance with paragraph 13 of the contract specifications.

8.0 DEFINABLE FEATURES OF CONSTRUCTION WORK

General Requirements

- a. Special project procedures to include coordination of work, project meetings, submittals, and quality control.
- b. Administrative Requirements.
- c. Environmental Protection.
- d. Job Conditions.

Site Work

- a. Excavation, Trenching and Backfilling for utilities Systems to include sewer, gravity, drainage, and water lines.
- b. Clearing and grubbing, backfilling for buildings.
- c. Grading.
- d. Fence, chain-link.
- e. Concrete for sidewalks and curbs.
- f. Bituminous Paving.

Concrete

- a. Concrete materials, concrete procedures, concrete formwork, forms, form ties and accessories, concrete reinforcement, concrete finishing, concrete curing and grouting.
- b. Testing.

Masonry

- a. Masonry procedures, mortar, mortar accessories, unit masonry, cavity wall construction to include bringing inner and outer wythes up simultaneously, reinforcement, wall ties, flashing, and cleaning.

- b. Acceptance of Sample Panel.
- c. Testing.

Metals

- a. Structural steel, framing to include metal materials and methods, metal fastening, metal joints, welding, expansion control, and miscellaneous metals
- b. Steel Roof Decking.
- c. High Strength Bolts.

Thermal and Moisture Protection

- a. Dampproofing
- b. Fireproofing
- c. Sealants

Doors and Windows

Metal doors and frames, special doors, metal windows, glazing and miscellaneous hardware, caulking.

Finishes

- a. Ceramic tile.
- b. Gypsum wallboard.
- c. Acoustical treatment to include metal suspension system for acoustical tile and lay-in panel ceiling.
- d. Resilient flooring.
- e. Painting.
- f. Furring (metal).

Specialties

- a. Metal toilet partitions
- b. Fire extinguisher cabinets
- c. Toilet accessories

Equipment

Fueling system for motor vehicles

Furnishings

Lockers

Special Construction

- a. Pre-engineered structures
- b. Liquid storage tanks

Mechanical

- a. Insulation to include:
 - (1) Pipes
 - (2) Ducts
 - (3) Equipment
 - (4) High density inserts, insulation protective shields, clips or U bolt support for multiple pipe hanger supports.
- b. Plumbing systems
 - (1) Waste/vent piping to include; underground soil piping, above ground soil piping.
 - (2) Interior piping rough-in to include; galvanized, black iron and copper, including drains, fittings, valves, and piping supports.

- (3) Plumbing fixtures to include flush valves, faucets, and accessories.
 - (4) Cleaning and operational testing.
- c. Heating systems
 - (1) Equipment and system accessories
 - (2) Fuel oil/gas piping and supports
 - (3) System testing and balancing
- d. Air distribution systems
 - (1) Equipment and accessories.
 - (2) Duct work to include galvanized supports, dampers, louvers, diffusers, duct line support and fire dampers.
- e. Automatic temperature control systems
 - (1) Equipment and materials
 - (2) Installation of materials and equipment
 - (3) System testing
- f. Sprinkler Systems
 - (1) Equipment
 - (2) Piping and supports
 - (3) Accessories

Electrical

- a. Exterior Electric Distribution, Aerial
 - (1) Pole setting.

- (2) Placement of crossarms, pins, insulators, pole line hardware and conductors.
- (3) Placement of fuse cutouts, surge arresters, reclosers, potheads, pole mounted transformers to include grounding conductors, grounding conductor testing and cable terminations.

b. Exterior electrical distribution, underground

- (1) Duct line excavation, placement of ducts and miscellaneous materials.
- (2) Placement of in ground junction or pull boxes and manholes.
- (3) Placement of duct bank concrete encasement.
- (4) Transformer pad placement.
- (5) Mounting of pad mounted transformers.
- (6) Cable placement to include splicing, fire-proofing, and cable terminations.
- (7) Grounding conductors and testing.

c. Electrical distribution, interior

- (1) Wiring methods to include conduit rough-in, raceway boxes, outlet boxes, panelboard cabinets, placement of conductors and conduit placement below the slab for slab-on-grade construction.
- (2) Wiring devices, panelboards, switch-boards, and lighting fixtures.
- (3) Motors and transformers.
- (4) Testing.

d. Fire Detection and Alarm System

- (1) Wiring methods to include conduit, ground rods, detectors, control panels, power supply, door holders, audible fire alarm and annunciator panel.
- (2) Testing.

SAMPLE

KEYES CONSTRUCTION COMPANY, INC.

DAILY QUALITY CONTROL REPORT

Daily Report No.: _____

Date: _____

Contract No.: _____

Project Title & Location:

Weather: _____ Precipitation: _____ in. Temp: _____ Min. _____ Max. _____

1. Contract/Subcontractors and Area of Responsibility:

NUMBER: TRADE : HOURS : EMPLOYER : LOCATION/DESCRIPTION WORK

[illegible]

2. Operating Plant or Equipment. (Not hand tools)

<u>Plant/Equipment</u>	<u>Date of Arrival/Departure</u>	<u>Date of Safety Check</u>	<u>Hours Used</u>	<u>Hours Idle</u>	<u>Hours Repair</u>
_____	_____	_____	____	____	____
_____	_____	_____	____	____	____
_____	_____	_____	____	____	____
_____	_____	_____	____	____	____
_____	_____	_____	____	____	____

7. Submittals Reviewed:

(a) Submittal No.	(b) Spec/Plan Reference	(c) By Whom	(d) Action
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

8. Offsite surveillance activities, including action taken:

9. Job Safety: (Report violations; corrective instructions given; corrective actions taken).

10. Remarks: (Instructions received or given. Conflict(s) in Plans and/or specifications).

Contractor's Verification: On behalf of the Contractor, I certify this report is complete and correct, and all materials and equipment used and work performed during this reporting period are in compliance with the contract plans and specifications, to the best of my knowledge, except as noted above.

Authorized CQC Rep at Site

Date

SAMPLE

Preparatory Phase Checklist

Contract No.: _____

Date: _____

Definable Feature: _____

Spec Section: _____

Government Rep Notified _____

Hours in Advance Yes _____ No _____

I. Personnel Present:

	<u>Name</u>	<u>Position</u>	<u>Company/Government</u>
1.	_____	_____	_____
2.	_____	_____	_____
3.	_____	_____	_____
4.	_____	_____	_____
5.	_____	_____	_____
6.	_____	_____	_____
7.	_____	_____	_____

(List additional personnel on reverse side)

II. Submittals

1. Review submittals and/or submittal log 4288. Have all submittals been approved?
Yes _____ No _____

If No, what items have not been submitted?

a. _____
b. _____
c. _____

2. Are all materials on hand? Yes _____ No _____

If No, what items are missing?

a. _____
b. _____
c. _____

3. Check approved submittals against delivered material. (This should be done as material arrives.)

Comments _____

III. Material storage

Are materials stored properly?

Yes _____ No _____

If No, what action is taken? _____

IV. Specifications

1. Review each paragraph of specifications.

2. Discuss procedure for accomplishing the work.

3. Clarify any differences.

V. Preliminary Work and Permits

Ensure preliminary work is correct and permits are on file.

If not, what action is taken? _____

VI. Testing

1. Identify test to be performed, frequency, and by whom.

2. When required? _____

3. Where required? _____

4. Review Testing Plan. _____

5. Has test facilities been approved? _____

Preparatory Phase Checklist (Cont'd)

VII. Safety

1. Review applicable portion of EM 385-1-1. _____

2. Activity Hazard Analysis approved? Yes _____ No _____

VIII. Corps of Engineers comments during meeting.

CQC REP

SAMPLE

Initial Phase Checklist

Contract No.: _____

Date: _____

Definable Feature: _____

Government Rep Notified _____ Hours in Advance Yes _____ No _____

I. Personnel Present:

<u>Name</u>	<u>Position</u>	<u>Company/Government</u>
-------------	-----------------	---------------------------

- | | | |
|----|-------|-------|
| 1. | _____ | _____ |
| 2. | _____ | _____ |
| 3. | _____ | _____ |
| 4. | _____ | _____ |
| 5. | _____ | _____ |
| 6. | _____ | _____ |

(List additional personnel on reverse side)

II. Identify full compliance with procedures identified at preparatory. Coordinate plans, specifications, and submittals.

Comments: _____

III. Preliminary Work. Ensure preliminary work is complete and correct. If not, what action is taken?

IV. Establish Level of Workmanship.

- | | |
|---|--------------------|
| 1. Where is work located? | _____ |
| 2. Is a sample panel required? | Yes _____ No _____ |
| 3. Will the initial work be considered as a sample? | Yes _____ No _____ |
- (If yes, maintain in present condition as long as possible).

V. Resolve any differences.

Comments: _____

VI. Check Safety.

Review job conditions using EM 385-1-1 and job hazard analysis.

Comments: _____

CQC REP

SAMPLE

CONTRACT NO. DACA 92-97-C-0111

Report No. _____

Date _____

CONCRETE PLACEMENT CARD

LOCATION _____

TIME: START _____ FINISH _____ CUBIC YARDS _____

	STATUS		STATUS
A-LINE & GRADE		G-GROUND BUSES &/OR WIRES	
B-SURFACE PREPARATION		Size	
		Location	
C-FORMS		Adequately Support	
Alignment		Welding	
Stability		H-ELECTRICAL BOXES & PANELS	
Form Surface		Size	
Special Blockouts		Location	
Safety of Work Area		Adequately Supported	
(runways, scaffold		Sealed Against Conc.	
& ladders)		I-PIPING	
Form Treatment		Size & Material	
Chamfer Strips		Location	
Cleaness		Support	
D-REINFORCEMENT		Sleeves	
Size		Leak Test	
Location		J-WATERSTOP	
Spacing		Size-Type	
Splices		Location	
Tie Wires		K-EXPANSION JOINT MAT.	
Chairs & Spacers		Size-Type	
E-EMBEDMENTS		Location	
Anchor Bolts		L-OTHER FEATURES (List)	
Embedded Steel			
F-CONDUITS			
Size			
Location			
Adequately Supported			
Flush Coupling or			
Stud-out Req't			
Clear of Obstruction			
Concrete Tight			

REMARKS _____

Q.C. System Manager

SAMPLE

CONCRETE SUMMARY

Report No. _____

Date _____

[illegible]

SAMPLE

KEYES CONSTRUCTION CO., INC.
ONE TACTICAL EQUIPMENT SHOP
CONTRACT NO. DACA 92-97-C-0111

Report No. _____

Date _____

TRIP REPORT

COMPONENT _____

VENDOR _____

SPEC REF. _____

PURPOSE OF TRIP _____

CONTACT _____

PERSONNEL PRESENT _____

SUMMARY _____

Q.C. System Manager

SAMPLE

PERMANENT MATERIALS REPORT

Project: _____

Location: _____

Materials: _____

Supplier: _____

Subcontractor: _____

Freight Line: _____

Damage Report: _____

Inspected By: _____

Quality Control System Manager

SAMPLE

DEFICIENCY REPORT NO.

Contractor: _____

Date: _____ Contract No.: _____

Location: _____

Reference Specifications Paragraph: _____

Reference Contract Drawing Sheet No.: _____

Deficiency: _____

Corrective Action: _____

Acknowledged: _____

Area Representative & Date

Corps of Engineers Field Rep.

Laboratory	Field
1	1
2	2
3	3
4	4
5	5
6	6
7	7
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[illegible]

Module 4: PRECONSTRUCTION CONFERENCE AND COORDINATION MEETING

Objectives: After completing this module, you will be able to:

- State the objective of the Preconstruction Conference.
 - State the purposes of the Coordination Meeting.
- A. General: There are two conferences held prior to the commencement of physical work. One covers all aspects of the contract and is called the Preconstruction Conference. The other covers Construction Quality Management and is called the Coordination Meeting. These meetings are a specific contract requirement.
- B. The Preconstruction Conference:
- The Preconstruction Conference is conducted as soon as possible after contract award and prior to the commencement of any physical work. The objective of the Preconstruction Conference is to review the contract clauses to include accident prevention, personnel requirements, and procedural matters. This conference is very important because it establishes the ground rules for administering the contract.
 - Contractor quality control normally is not discussed in detail at this conference. The subject is so important it deserves special attention and the personnel attending may not be involved in the day-to-day on-site activities. The degree of quality control-related discussion depends largely on the scope and magnitude of the contract and on the individuals from each organization that are present.
 - It is a government responsibility to take detailed minutes of the conference and provide copies to all participants.
- C. The Coordination Meeting:
- This meeting is scheduled, convened and conducted by the government. Normally, this is the area, resident, or project engineer. As with the Preconstruction Conference, this meeting must be held before any physical work begins.

- The purposes of the Coordination Meeting are:
 - To achieve a mutual understanding with the contractor of his role in quality control.
 - To review the QC Plan with the contractor. The government must receive and review the QC Plan before the meeting. Acceptance of the QC Plan can be accomplished after the meeting.
 - To establish a good working relationship between the government and the contractor.
- Personnel, both government and contractor, who will be directly involved in construction quality management should be present. They will be working together on a day-to-day basis on the quality management aspects of the project, and they need to come to mutual understandings before the project actually begins. If subcontractors are to be involved in quality control, their responsible personnel should also attend, so that they can receive the information they need "first-hand."
- The Coordination Meeting will normally include a full spectrum of CQM requirements. A sample Coordination Meeting Agenda is included at the end of this module.
- It is a government responsibility to take detailed minutes of the meeting and provide copies to all participants. It is vital that everything of importance is included in these minutes, since verbal understandings tend to be remembered differently by different individuals. If any disagreement occurs between the government and the contractor, the minutes will prove invaluable. These minutes must be signed by both the contractor and the government.

EXERCISE

Module 4

1. What is the objective of the Preconstruction Conference?
2. Why is the Preconstruction Conference important?
3. Who schedules, convenes, and conducts the Coordination Meeting?

4. What are the primary purposes of the Coordination Meeting?

5. Who attends the Coordination Meeting?

SAMPLE

COORDINATION MEETING AGENDA

- I. Introduction
 - A. Area/Resident Engineer
 - B. Project Engineer
 - C. Quality Assurance Personnel
 - D. Contractor Personnel
- II. CQC Specifications
- III. Contractor Quality Control System
 - A. Quality Control Staff
 - 1. "Chain of Command"
 - 2. Individual Responsibilities
 - B. Submittals
 - 1. Scheduling (ENG Form 4288) Updates
 - 2. ENG Form 4025
 - 3. Follow-up of Disapprovals
 - C. Testing
 - 1. Frequency
 - 2. Who Performs/Qualifications

3. Lab Approval
 4. Documentation with Auditable Trail
- D. Quality Control Daily Reports
1. Contractor Name and Address
 2. Project Name, Contract Number, Location, Date, and Report Number
 3. Weather
 4. Contractor/Subcontractor Area of Responsibility
 5. Materials/Equipment Delivered to Job Site
 6. Record any Preparatory, Initial, and Follow-up Phase activities held. Note results of surveillance or necessary corrections.
 7. Testing Performed and Results Noted
 8. Verbal Instructions Received
 9. Controversial Issues
 10. Signed by Contractor Quality Control Representative
- E. Definable Features of Work
- F. Three-Phase Control System
1. Preparatory
 - a. Shop Drawings
 - b. Work to be built upon
 - c. Equipment
 - d. Control Testing

- e. Government Furnished Equipment (where applicable)
 - f. Sample Panels
 - g. Construction Methods
 - h. Safety
 - i. Recordkeeping
 - j. Notification of Government Representative
 - 2. Initial
 - a. Contract required with respect to quality
 - b. Corrective measures
 - c. Recordkeeping
 - d. Notification of Government Representative
 - e. Safety
 - 3. Follow-Up
 - a. Continuing Quality
 - b. Corrective Measures
 - c. Recordkeeping
- G. Contractor Quality Control Plan
- 1. Correct Deficiencies
 - 2. Discuss
 - a. Procedure to be followed when deficiencies are discovered.
 - b. Cooperation

3. Changes to the Plan
 - a. Required to revise plan if something proves to be incorrect after construction begins.
 - b. Proposed changes must be submitted in writing to Area/Resident Engineer and accepted.
4. Administration of the Quality Control Plan is the sole responsibility of the contractor.

H. Punch-Out Inspection

1. Deficiencies noted by QC Representative
2. Corrected prior to Pre-final/Final Inspection

I. Pre-final/Final Inspection

1. Conducted with contractor, Corps, and using agency or customer personnel.
2. Additional punch-list items noted.
3. Payment withheld until corrected.

IV. Government Quality Assurance

V. Discussion

Module 5: SUBMITTALS

Objectives: After completing this module, you will be able to:

- State the purpose of submittal procedures.
- Describe government responsibilities for submittal review and/or approval.
- Describe contractor responsibilities for the scheduling and control of submittals.
- List the information the contractor must furnish on the submittal control document (ENG Form 4288 - Submittal Register).
- List the information the contractor must furnish on the transmittal form (ENG Form 4025).

A. General:

1. Submittals are classified as "Government Approved" (GA) or "For Information Only" (FIO). Submittals which will normally require government approval are: extensions of design, critical materials, variations, or those involving equipment whose compatibility with the entire system must be checked. All submittals not requiring government approval are for information only. It is imperative that the contractor's QC representative review all submittals because the government only spot checks FIO submittals. This emphasizes the government's reliance upon contractor QC approvals. The Contract Clause entitled "Specifications and Drawings for Construction," and specification Section 01300 discuss specific definitions and procedures. The Submittal Register, (Engineer Form) ENG Form 4288, identifies those submittals requiring government approval.
2. Use of ENG Form 4025: The contractor must use ENG Form 4025, "Transmittal of Shop Drawings, Equipment Data, Material Samples, or Manufacturer's Certificates of Compliance," for transmitting submittals. A sample ENG Form 4025 is provided in the sample section of this module. Instructions for use are contained on the back of the form.

3. Typical types of submittals are:

- data,
- drawings,
- instructions,
- schedules,
- statements,
- reports,
- certificates,
- samples,
- records, and
- O&M manuals

4. The primary responsibility for overall management and control of submittals lies with the contractor.

B. Purpose: Submittals are required by the contract in order to regulate the timely flow of materials to be incorporated into work. They are necessary to demonstrate that the proposed materials, etc., are in compliance with the contract. All required submittals must be provided by the contractor in time to allow for the review, approval, procurement, delivery, and CQC preparatory phase of an item before it is needed for construction. Submittals are indispensable in assuring and controlling construction quality and must be given the attention required.

C. Contractor Submittal Responsibilities:

- The contractor must integrate the submittal process into his Quality Control Plan. He must delegate submittal responsibilities to the proper individuals on his staff.
- Submittals are considered by the government to be important. The contractor must assure that onsite management remains attentive to submittal procedures at all times.
- CQC personnel are responsible for ensuring, through detailed review, that all submittals are in full compliance with the contract.
- The contractor must review the government prepared Submittal Register and add any needed additional submittals.

- The contractor must check the submittal schedule requirements against the Network Analysis System (NAS) or other approved construction schedule.
- The contractor constantly maintains and adjusts dates on the register as required by the contract activities to ensure the document reflects current information.
- All variations must be fully described, identified and justified in the transmittal package. This is explained in specification Section 01300 and in the instructions on ENG Form 4025. If a variation is not identified on ENG Form 4025, the government may rescind any inadvertent approval.
- The contractor assures that work must not be permitted to begin without properly approved submittals.
- The "Buy American Act - Construction Materials" must be considered in the submittal process because it significantly impacts what will be acceptable on government projects.

D. Government Submittal Responsibilities:

- The government will prepare a list of submittals required for each contract. This list will be prepared on a submittal register (ENG Form 4288). The annotated submittal register will be incorporated into the specifications prior to advertisement.
- Review a minimum 10% of FIO submittals.
- Review and approve submittals that are required to be GA.
- An important aspect of the government's quality assurance role is to enforce submittal requirements. In the course of the project, if it is determined that the contractor's quality control personnel are not properly satisfying submittal requirements, corrective action will be taken.

E. Controlling and Scheduling:

1. Submittal activities may be required to be incorporated into the construction schedule in order that submittal progress can be tracked in conjunction with overall progress. Care must be taken that the schedule accurately reflects the status on ENG Form 4288.
2. Regardless of the type schedule specified, ENG Form 4288, "Submittal Register," is used for submittal control and scheduling. (A sample ENG Form 4288 is provided in the sample section of this module.) Generally, the information required is self-explanatory. However, several items need clarification.
 - The NAS activity code, is used only when a network schedule is required and for those submittals that have been included as activities.
 - Item Number is to be completed by the contractor.
 - The Contractor Schedule Dates Columns should project when submittals will be submitted, when approval is needed, and when the material is needed. This information should be updated every 30 days as required by the specification.
3. Software for microcomputers which automates the submittal register has been developed by the government. This will be useful to both the contractor and the government. The Resident Management System (RMS) is discussed in a later module.

EXERCISE

Module 5

1. What is the purpose of submittals?
2. What is the process the contractor must use to request a variation?
3. What are the contractor's submittal responsibilities?

4. What are the government's submittal responsibilities?

5. What information must the contractor provide in his submittal control document (ENG Form 4288 - Submittal Register)?

SPECIFICATION SECTION

SAMPLE

TRANSMITTAL OF SHOP DRAWINGS, EQUIPMENT DATA, MATERIAL SAMPLES, OR MANUFACTURER'S CERTIFICATES OF COMPLIANCE <i>(Read instructions on the reverse side prior to initiating this form)</i>		DATE	TRANSMITTAL NO.
---	--	------	-----------------

SECTION I - REQUEST FOR APPROVAL OF THE FOLLOWING ITEMS *(This section will be initiated by the contractor)*

TO:	FROM:	CONTRACT NO.	CHECK ONE: <input type="checkbox"/> THIS IS A NEW TRANSMITTAL <input type="checkbox"/> THIS IS A RESUBMITTAL OF TRANSMITTAL _____
-----	-------	--------------	---

SPECIFICATION SEC. NO. (Cover only one section with each transmittal)	PROJECT TITLE AND LOCATION	CHECK ONE: THIS TRANSMITTAL IS FOR <input type="checkbox"/> EIR <input type="checkbox"/> ENV. GOV'T APPROVAL

[illegible]

REMARKS

I certify that the above submitted items have been reviewed in detail and are correct and in strict conformance with the contract drawings and specifications except as otherwise stated.

NAME AND SIGNATURE OF CONTRACTOR

SECTION II - APPROVAL ACTION

ENCLOSURES RETURNED (List by Item No.)	NAME, TITLE AND SIGNATURE OF APPROVING AUTHORITY	DATE

INSTRUCTIONS

1. Section I will be initiated by the Contractor in the required number of copies.
2. Each transmittal shall be numbered consecutively in the space provided for "Transmittal No.". This number, in addition to the contract number, will form a serial number for identifying each submittal. For new submittals or resubmittals mark the appropriate box; on resubmittals, insert transmittal number of last submission as well as the new submittal number.
3. The "Item No." will be the same "Item No." as indicated on ENG FORM 4288-R for each entry on this form.
4. Submittals requiring expeditious handling will be submitted on a separate form.
5. Separate transmittal form will be used for submittals under separate sections of the specifications.
6. A check shall be placed in the "Variation" column when a submittal is not in accordance with the plans and specifications--also, a written statement to that effect shall be included in the space provided for "Remarks".
7. Form is self-transmittal, letter of transmittal is not required.
8. When a sample of material or Manufacturer's Certificate of Compliance is transmitted, indicate "Sample" or "Certificate" in column c, Section I.
9. U.S. Army Corps of Engineers approving authority will assign action codes as indicated below in space provided in Section I, column i to each item submitted. In addition they will ensure enclosures are indicated and attached to the form prior to return to the contractor. The Contractor will assign action codes as indicated below in Section I, column g, to each item submitted.

THE FOLLOWING ACTION CODES ARE GIVEN TO ITEMS SUBMITTED

A --	Approved as submitted.	E --	Disapproved (See attached).
B --	Approved, except as noted on drawings.	F --	Receipt acknowledged.
C --	Approved, except as noted on drawings. Refer to attached sheet resubmission required.	FX --	Receipt acknowledged, does not comply as noted with contract requirements.
D --	Will be returned by separate correspondence.	G --	Other (Specify)

10. Approval of items does not relieve the contractor from complying with all the requirements of the contract plans and specifications.

Module 6: QUALITY MANAGEMENT DURING CONSTRUCTION

Submodule 1: Introduction

Objectives: After completing this submodule, you will be able to:

- Define the function and importance of Construction Quality Assurance.
 - Define the function and importance of Contractor Quality Control.
- A. **Quality Assurance:** The primary function of quality assurance is to obtain completed construction that meets all contract requirements. Assurance is defined as a degree of certainty. Quality assurance personnel continually assure--or make certain--that the contractor's work complies with contract requirements.
- B. **Quality Assurance Personnel:** The role of quality assurance personnel is to assure that the CQC system is functioning properly. To do this, QA personnel:
- Examine the quality control methods being used to determine if the contractor is properly controlling construction activities.
 - Make certain that the necessary changes are made in the contractor's QC system, if excessive construction deficiencies occur.
 - Assist the contractor in understanding and implementing the contract requirements.
 - Examine ongoing and completed work.
 - Review QC documentation to assure adequacy.
- C. **Contractor Quality Control:** The primary function of CQC is the successful execution of a realistic plan to ensure that the required standards of quality construction will be met. In CQC, the contractor defines procedures to manage and control his own, all subcontractors', and all suppliers activities so that the completed project complies with contract requirements.
- D. **Quality Control Personnel:** As stated previously, CQC is a contractor responsibility. This includes:

- Produce the quality specified in the plans and specifications,
- Develop and maintain an effective CQC system,
- Perform all control activities and tests, and
- Prepare acceptable documentation of CQC activities.

The contractor also is required to place a competent representative onsite to oversee the CQC system. He must have full authority to act for the contractor on CQC matters. His responsibilities include workmanship, methods, and techniques to ensure that all work is performed properly by qualified and careful craftsmen.

EXERCISE

Submodule 6.1

1. What is the primary function of QA?
2. What is the role of QA personnel?
3. What is the primary function of CQC?
4. What are the roles of QC personnel?

Module 6: QUALITY MANAGEMENT DURING CONSTRUCTION

Submodule 2: Three-Phase Control System

Objectives: After completing this submodule, you will be able to:

- Define the purpose of control of onsite construction through the Three-Phase Control System.
 - List the responsibilities of QC personnel regarding the three-phase control system.
- A. Purpose: The three phases of control (preparatory, initial, and follow-up) are the core of the Construction Quality Management System. The primary purpose of the Three-Phase Control System is to require the contractor to plan and schedule the work to ensure that he is prepared to start each new feature of work. In Module 3, Submodule 1, we mentioned the three-phase control system as a required part of the contractor's quality control plan.
- B. Three-Phase Control Responsibility:
- Develop, schedule and implement procedures for tracking control phase meetings for definable features of work in the QC Plan.
 - Notify appropriate personnel of time, date and agenda.
 - Conduct Meetings (preparatory and initial).
 - Document actual discussions and provide minutes to attendees.
 - Monitor work in place through follow-up phase.
 - Conduct additional control phase meetings, as needed.
- C. The Three-Phase Control System:
1. **Preparatory Phase:** This phase shall be performed prior to beginning work on each definable feature of work. Perform this work as detailed below:
 - A review of each paragraph of applicable specifications and references.

- A review of contract plans.
 - A check to assure that all materials and/or equipment have been tested, submitted, and approved.
 - A check to assure that provisions have been made to provide required control inspection and testing.
 - Examination of the work area to assure that all required preliminary work has been completed.
 - A physical examination of required materials, equipment, and sample work to assure that they are on hand and conform to approved shop drawings or submitted data.
 - A review of the appropriate activity hazard analysis.
 - Discussion of procedures for constructing the work including the review of repetitive deficiencies.
- The government shall be notified in advance of beginning any of the required action of the preparatory phase as required in the CQC specifications.
 - This phase shall include a meeting conducted by the CQC representative and attended by the superintendent, other CQC personnel (as applicable), and the foremen responsible for the definable feature. The results of the preparatory phase actions shall be documented by separate minutes prepared by the CQC representative and attached to the daily CQC report.
2. **Initial Phase:** This phase must be accomplished at the beginning of a definable feature of work. The "Initial Phase" will verify that control for the work developed in the "Preparatory Meeting" is implemented and the work is performed to the level of workmanship mutually agreed to. Perform this work as detailed below:
- Review minutes of Preparatory Meeting.
 - Check preliminary work.
 - Verify adequacy of controls to ensure full contract compliance.

- Establish level of workmanship.
 - Resolve all differences.
 - Check safety to include compliance with the safety plan and activity hazard analysis. Review the activity hazard analysis with workers.
- The government shall be notified in advance of the beginning of the Initial Phase as required in the CQC specifications.
 - The QC representative is in charge of the Initial Phase Meeting. Separate minutes of this phase shall be prepared by the CQC representative and attached to the daily QC report. The initial phase shall be repeated for each new crew to work onsite, or any time established level of workmanship is not being met.
3. **Follow-up Phase:** Daily checks shall be performed to assure continuing compliance with contract requirements, including control testing, until completion of the particular feature of work. The checks shall be made a matter of record in the CQC documentation. Final follow-up checks shall be conducted and all deficiencies corrected prior to the start of additional features of work. QC personnel should continually refer back to the standards set in the "Preparatory and Initial Phases."
- D. **Cautionary Note:** QC personnel, in the midst of day-to-day duties, can easily fall into the trap of only working to detect deficiencies when in fact his role is to prevent deficiencies.

EXERCISE

Submodule 6.2

1. What is the primary purpose of the three-phase control system?

2. Regarding the three-phase control system, what are the responsibilities of quality control personnel?

PRACTICAL EXERCISE

Submodule 6.2

PREPARATORY PHASE MEETING EXERCISE

You are involved in the construction of a \$22,000,000 two-bay hanger at March Air Force Base in California. Included in the project is 2,000 feet of 24 inch diameter storm drainage pipe. Manholes are to be installed every 300 feet. Storm drainage pipe is listed in the Quality Control Plan as a definable feature of work. The contractor plans to use reinforced concrete pipe and pre-cast manholes.

SCOPE: Install 2,000 feet of 24 inch storm drainage pipe. Pre-cast manholes shall be installed every 300 feet.

Task: Prepare to attend preparatory meeting to begin the work. Use the check list included as a guide.

Assumptions: Pipe is on site
Submittals are approved
Excavation permit is issued
Safety plan covers the work and is satisfactory
Layout work is complete

You are: Resident Engineer

Project Engineer

Onsite Quality Assurance Person

TEAM 1

PRACTICAL EXERCISE

Submodule 6.2

PREPARATORY PHASE MEETING EXERCISE

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SCOPE: Install 2,000 feet of 24 inch storm drainage pipe. Pre-cast manholes shall be installed every 300 feet.

Task: Perform preparatory meeting to begin the work. Use the check list included as a guide.

Assumptions:

- Pipe is on site
- Submittals are approved
- Excavation permit is issued
- Safety plan covers the work and is satisfactory
- Layout work is complete

You are: Project Superintendent

Quality Control System Manager

Site Work Subcontractor's Superintendent

Storm Drainage System Second Tier Subcontractor's Foreman

Safety Engineer

TEAM 2

SAMPLE

Preparatory Phase Checklist

Contract No.: _____ Date: _____

Definable Feature: _____ Spec Section: _____

Government Rep Notified _____ Hours in Advance Yes _____ No _____

I. Personnel Present:

	<u>Name</u>	<u>Position</u>	<u>Company/Government</u>
1.	_____	_____	_____
2.	_____	_____	_____
3.	_____	_____	_____
4.	_____	_____	_____
5.	_____	_____	_____
6.	_____	_____	_____
7.	_____	_____	_____

(List additional personnel on reverse side)

II. Submittals

1. Review submittals and/or submittal log 4288. Have all submittals been approved?
Yes _____ No _____

If No, what items have not been submitted?

a. _____
b. _____
c. _____

2. Are all materials on hand? Yes _____ No _____

If No, what items are missing?

a. _____
b. _____
c. _____

3. Check approved submittals against delivered material. (This should be done as material arrives.)

Comments _____

III. Material storage

Are materials stored properly? Yes _____ No _____

If No, what action is taken? _____

IV. Specifications

1. Review each paragraph of specifications.

2. Discuss procedure for accomplishing the work.

3. Clarify any differences.

V. Preliminary Work and Permits

Ensure preliminary work is correct and permits are on file.

If not, what action is taken? _____

VI. Testing

1. Identify test to be performed, frequency, and by whom.

2. When required? _____

3. Where required? _____

4. Review Testing Plan. _____

5. Has test facilities been approved? _____

VII. Safety

1. Review applicable portion of EM 385-1-1. _____

2. Activity Hazard Analysis approved? Yes _____ No _____

VIII. Corps of Engineers comments during meeting.

CQC REP

Module 6: QUALITY MANAGEMENT DURING CONSTRUCTION

Submodule 3: Documentation

Objectives: After completing this submodule, you will be able to:

- Explain the purpose and importance of the Contractor Quality Control (CQC) Report.
- List the components of the CQC Report.
- Explain the purpose and importance of the government Quality Assurance (QA) Report.
- Discuss the review and use of quality management reports.

A. Quality Management Record Keeping.

A comprehensive record keeping and information exchange system is an indispensable quality management tool. In addition to identifying specific deficiencies, careful report analysis will also detect patterns in the team's performance. If these patterns are detrimental, early detection and correction will save time, effort, and money for both the government and the contractor.

B. The Contractor Quality Control Report.

- The requirement for the contractor to submit daily QC reports is established in the QC specification. As discussed previously, the Coordination Meeting should include a detailed discussion of reporting procedures, information required in the reports, and the importance of the reports. The QC Report is to be submitted at a prescribed time every day, and all information relating to QC activities is to be included in the report.
 - There is no form specified for the QC Report. Regardless of the form and format used, it must include the information outlined in the QC specification. (A sample QC Report is located in the sample section of submodule 3.2.)
 - Major elements of information required in the QC Report include, but are not limited to the following:

- Contractor/subcontractor and their area of responsibility.
 - Operating plant/equipment with hours worked, idle, or down for repair.
 - Work performed each day, giving location, description, and by whom. When a Network Analysis System (NAS) is used, identify each phase of work performed each day by NAS activity number.
 - Test and/or control activities performed with results and references to specifications/drawings requirements. The control phase should be identified (Preparatory, Initial, Follow-up). List deficiencies noted along with corrective action.
 - Quantity of materials received at the site with statement as to acceptability, storage, and reference to specifications/drawings requirements.
 - Submittals reviewed, with contract reference, by whom, and action taken.
 - Off-site surveillance activities, including actions taken.
 - Job safety evaluations stating what was checked, results, and instructions or corrective actions.
 - Instructions given/received and conflicts in plans and/or specifications.
 - Contractor's verification statement.
- When activities are completed, they must be so noted on the daily QC Report. The government conducts a final follow-up inspection for completed activities.
 - The QC representative may attach separate reports for subcontractor work, or these reports may be combined into one consolidated report.

- The QC reports must present an accurate and complete picture of QC activities. QC reports should not concentrate only on work items that have been completed, but also must provide evidence of control activities. They should be precise, factual, legible, as objective as possible, and emphasize QC actions.
- QA personnel evaluate QC reports as they are received. If statements are discovered in the report that are contrary to QA personnel's knowledge of the work, action will be taken to resolve the differences. The contractor may be asked to submit a supplemental report containing corrections.

C. The Government Quality Assurance Report.

The QA Report is the government's record of project-related events and is prepared for each visit day. The QA report is not intended to duplicate information contained on the QC report.

D. Deficiency Tracking System.

Included as a part of the CQC program is a requirement for a formal deficiency tracking system. As outlined in the accepted QC plan, it shall consist of a cumulative list of job deficiencies. This includes items identified by QA personnel, QC staff, testing failures, etc. This list shall be continually maintained with dates of corrective action. The system is subject to review by the government.

EXERCISE

Submodule 6.3

1. What are the major components of the sample Quality Control Report in submodule 3.2?
2. How often are Quality Control and Quality Assurance Reports required?
3. Following (3a through 3e) are situations relating to documentation and three-phase control. Read the situations carefully, and respond to the requirement(s) accompanying each.
 - a. The G. J. Company has a contract for rehabilitation of three barracks. The work consists primarily of addition of partitions and installation of A/C equipment and duct work. On the day duct work installation started, the Daily Report stated: "Started installing duct work today. Everything looked okay." Is this report feature adequate? EXPLAIN.
 - b. The G. J. Company continues work on rehab contract. Today's activities involve the continuation of insulating duct work. After several review sessions with the contractor with regard to proper documentation of activities, his comments were, "Insulation of duct work being done in accordance with specifications, vapor barrier was

ripped in a couple of places and insulator was a little light in use of staples." Rewrite the contractor's comments to make them acceptable.

- c. The Paw Power Construction Company has a contract for construction of a high-rise administration building. Work was in early stages of construction and a subcontractor had just completed backfilling sanitary sewer lines. The utilities sub foreman had been designated as CQC representative for this portion of the work. His report was attached to the main report. A preparatory and initial phase have been performed and recorded earlier. This report stated, "All work completed in accordance with directions received at preparatory phase."

(1) Is it permissible to accept subreports attached to the Daily Report?

(2) Is it permissible to reference the preparatory phase?

(3) Is anything missing?

- d. Results of Surveillance: Bowers installed base of manhole #2 approximately 10 ft. east of its correct location. Pipe between manholes #6 and #2 is being removed and the pipe between manholes #3 and #2 is being extended to a new location for manhole #2.

(1) What does this report say?

(2) Rewrite the report so that it states clearly what is intended.

- e. You are the QC System Manager. You are to begin installation of ceramic floor and wall tile. Both the floor and the wall are to receive a setting bed. The floor has floor drains, and waterproofing has been completed. The wall has electrical receptacles.

(1) Who would you want at the initial phase of the work?

(2) What would you check? —

(3) What items should be contained in the QC Report covering the Initial Phase?

Module 6: QUALITY MANAGEMENT DURING CONSTRUCTION

Submodule 4: Testing

Objectives: After completing this submodule, you will be able to:

- Discuss the objectives of contractor and government testing.
- Describe contractor testing procedures.
- List testing requirements.

A. Importance of Testing:

Testing is an extremely important part of CQM. If tests are not performed properly, there are many construction procedures that cannot be confirmed as adequate. Visual observation alone is insufficient.

B. Types of Tests:

1. QC Testing: The contractor performs control testing to determine whether construction procedures are producing the desired contractual product.
2. QA Testing: The government performs assurance testing to verify that the contractor's control testing is adequate.

C. Procedures:

1. The contractor must outline proposed "testing procedures" as defined in Section 01440 in his QC Plan. These proposed procedures must be discussed at the Coordination Meeting. Any disagreements regarding testing procedures must be settled before construction begins.
2. The contractor must provide a list of required control tests and specify whether the tests are to be performed by an independent, approved testing laboratory, or through the use of his own personnel and facilities.

3. Regardless of which method of testing the contractor uses, he is required to assure that specified laboratory procedures are used and that laboratory facilities are certified.
4. QC testing is verified in a random manner by QA testing. QA tests are unannounced sporadic tests that repeat QC tests. QA testing can be performed by :
 - a. Government personnel using the contractor's equipment and facilities,
 - b. An independent testing laboratory, or
 - c. A field office, district, or division government laboratory.
5. QC personnel must be knowledgeable concerning laboratory and testing procedures. They must be able to visually recognize proper and improper testing procedures. All involved personnel should become aware of the methods to be used for and the extent of QC testing.
6. Before testing begins, the following questions should be answered:
 - a. Has all required testing been identified?
 - b. Are test reporting requirements understood?
 - c. Have laboratory facilities and testing equipment been verified as acceptable?
 - d. Are laboratory personnel qualified?
 - e. Has the calibration of equipment been verified as accurate?
 - f. Is there a procedure for documenting corrective steps?
7. After QC testing has begun, a thorough examination must be made of the test reports submitted to ascertain that:
 - a. Reports are being submitted for all tests performed,

- b. Reports are complete and accurate, and
 - c. Failing tests must be retested and cross referenced to the original failing test.
- D. Test Tracking System: In accordance with Section 01440, the contractor must establish and maintain a system to track verification, control and acceptance tests. Each planned test type and frequency must be entered into the tracking system prior to beginning work. Results and dates of individual tests are to be added to the system as they are performed. Any failing test results will have retests performed, entered into the system and cross referenced. The tracking system must be reviewed frequently to assure that any activity underway is having all planned tests performed as scheduled.

EXERCISE

Submodule 6.4

1. Define QC testing.
2. Define QA testing.
3. Who performs QC tests?

4. Who performs QA tests?

5. What questions should be answered before testing begins?

Module 6: QUALITY MANAGEMENT DURING CONSTRUCTION

Submodule 5: Completion of Work

Objective: After completing this submodule, you will be able to:

- Describe project completion procedures.

Quality Management Completion Procedures:

- **Testing of Completed Systems:** Testing of completed systems shall be performed as required by the technical specifications of the contract.
- **Contractor Punch-Out:** Near the completion of all work or any increment thereof, the contractor prepares a punch list and makes corrections. Quality assurance personnel will not prepare the contractor's deficiency list. The contractor should correct deficiencies promptly so that project schedules are met. All major deficiencies noted during this contractor punch-out inspection must be corrected prior to the pre-final inspection.
- **Pre-Final and Final Inspections:** Participating in the pre-final and final inspections will be QA personnel and CQC representatives. CQC will assure that all deficiencies noted during the pre-final inspection are corrected prior to the final inspection, and report the status of corrective actions to the government. The customer is invited to the final inspection. Any deficiencies noted at these inspections by user personnel, whether design or construction related, will be examined by the government and the contractor notified if corrective action is required under the terms of the contract.
- **Complete As-Built Drawings:** As-built drawings are updated continually throughout the project. During the final stages of construction, CQC will review and complete these drawings. While the status of as-built drawings is a concern throughout the project, it is of particular significance, as the project comes to an end, to prevent any loose ends.
- **Operations and Maintenance (O&M) Manuals:** CQC will assure submittal of all required operation and maintenance data in accordance with scheduled submittal dates.

- Instruction and Training Procedures: If the contract requires operation and maintenance training of customer personnel, the CQC will make certain all specified training has been conducted by qualified instructors.
- Materials Turnover: The CQC will verify that all required keys, spare parts and materials have been sorted, identified, and demonstrated to be usable prior to final inspection.
- Warranty: The CQC will ensure that all warranty information is provided. Procedures for warranty notification and correction should be in place.

EXERCISE

Submodule 6.5

What is the appropriate chronological order for the quality management completion procedures listed in this submodule? Explain.

Module 7: MAKING THE SYSTEM WORK

Objectives: After completing this module, you will be able to:

- List problems which may occur during construction.
 - Name and discuss the means by which requirements may be enforced.
 - List corrective measures which may be taken by the government and the authority for each.
- A. Problem Categories: Problems encountered during construction vary according to the specific project. Most problems, however, fit into one or more of the following categories:
- Delays. There may be delays in submittals, in the correction of deficiencies, or because of lack of contractor's acceptance of the CQC principles.
 - Planning and Control. Many problems can be caused by a lack of planning and control and a failure to take corrective action in the planning and control process.
 - Testing. Improper, inadequate, or untimely testing can adversely affect the project.
 - Documentation. Problems occur because of late, incomplete, or incorrect documentation. Making a written record of quality control action and test results is as important as taking the actions. The CQM Reporting System may cause appropriate action to be taken, or may be the basis of settlement of expensive claims at a future date, after people directly involved are no longer available. If documentation is inadequate, communications break down, then the legal positions of both the government and the contractor are jeopardized.
 - Misunderstanding of CQC Responsibility. This problem is often the result of a lack of review of the contract QC requirements, a lack of familiarity with the QC Plan, or failure to communicate roles to other personnel involved in the QC process. When possible, this should be solved at the field level.

Personal one-on-one discussion and actions at the field level often provide acceptable solutions to the problems. If discussions with onsite personnel are not fruitful, the problem must be elevated to the next level. The important thing is for the problem to be identified early so that it can be prevented or corrective action can be taken. If an agreement cannot be reached, the government makes the final determination.

B. Government Options: Proper effective QC can prevent adverse government actions. However, if efforts at the field level do not bring the desired result, the government has no choice but to initiate action under the Contract Clauses of the contract that provide the means for enforcing contract compliance.

- Requiring contractor removal and replacement of deficient materials and/or workmanship - Contract Clause, Inspection of Construction, FAR 52.236-12.
 - This contract clause allows the government to require the contractor to expose, test, and ultimately remove and replace deficient work.
 - If necessary the government may employ another contractor to make the corrections performed if he refuses to correct it himself. If adversarial relationships develop, which could be costly to the contractor, a copy of directive type letters to the contractor should be furnished to the surety company.
- Withhold Payment - Contract Payment Clause.
 - Grounds for withholding payment include the contractor's failure to:
 - Perform in accordance with the terms of the contract;
 - Provide the Quality Control Plan giving assurance of his intent and ability to comply with quality standards;
 - Build to quality standards.
 - While the government is obligated to pay for satisfactorily completed work, it has no obligation to pay a contractor for deficient work.

- Requiring removal of unqualified personnel - Contract Clause, Material and Workmanship, FAR 52.236-5. If contractor personnel are deemed to be incompetent, careless, or otherwise objectionable, the government can require the removal of such personnel from the project. However, under other provisions of the contract, if the government deems the QC staff to be too small, but not incompetent, it may direct the addition of personnel.
- Requiring the contractor to assume personal supervision - Contract Clause, Superintendence by the Contractor, FAR 52.236-6. If the contractor does not provide an adequate superintendent, the contract allows the Contracting Officer to require the contractor to assume personal supervision of the work.
- Halting Work. Another government option is halting work until deficiencies are corrected.
 - The Contracting Officer may direct the contractor to cease work and any item or work feature pending satisfactory correction of any deficiency in that work--particularly if the defective work is to become inaccessible if further work proceeds.
 - If the contractor refuses to stop and correct the deficiency immediately, a letter from the Contracting Officer Representative may be issued, directing the contractor to cease that particular operation.
- Issuing an unsatisfactory performance appraisal.
 - If the contractor fails to correct serious deficiencies in his performance, he may be cited as unsatisfactory at the conclusion of the project.
 - Interim unsatisfactory appraisals may be issued at any time before construction is completed. This will afford the contractor the opportunity to correct his deficient operations and avoid issuance of a final unsatisfactory appraisal at contract closeout.
 - Even a single unsatisfactory appraisal can have an effect on future awards of Corps' contracts to that contractor.

- Conversely, outstanding work by a contractor is reflected in outstanding performance appraisals, safety awards, and public recognition.
 - Terminate the Contract - Contract Clause, Default (Fixed-Price Construction) FAR 52.249-10. The most drastic type of action is to terminate the contract. In most cases, termination for default is not in the best interest of the government. Termination action is taken only after all else fails.
- C. Making the "System" Work: QC personnel must act quickly and confidently when problems are discovered. They cannot sit back and hope that problems will correct themselves. Their job is to control construction quality by taking action to make certain that problems are corrected and prevented. The government is serious about CQC and will hold the contractor responsible for contract compliance. —

EXERCISE

Module 7

1. Name the categories of problems that normally occur during construction.
2. What options are available to the government under the Contract Clauses of the contract?
3. Analyze the cases on the following pages and answer the questions included with each. Be prepared to discuss your answers with other members of the class.
 - a. Contractor is constructing a commissary. The contract was awarded in April, which allowed for sufficient time to enclose the building before onset of cold weather. Building is scheduled to be complete in May of next year, which necessitates doing the inside finish work during winter months. The customer has scheduled delivery of equipment and stock for June. Work was progressing satisfactorily and the contractor was about to start roofing operations in mid-September when the resident engineer discovered the contractor was installing untreated lumber for edge strips, curbing, etc., which was in violation of the specifications. Work was stopped, and after some investigation, contractor advised the resident engineer that the best

delivery on treated lumber was eight weeks, which would delay enclosing the building and ultimately delay turnover to the customer. The contractor requested waiver of treated lumber requirement.

(1) Where did the contractor's control system break down?

(2) Where did the government assurance system break down?

(3) What are the resident engineer's courses of action?

- b. Contract involves construction of a major barracks complex including 25 dormitories. Project is 75% complete and occupied by troops when the customer complains that the opaque panel in the lower window section is allowing precipitation to penetrate during driving rain. The leaks have stained carpet and ceiling tile. Investigation reveals that leaking panels are improperly glazed and do not conform with the contract drawings and specifications. All windows had been factory glazed and were warehoused onsite. Although a vinyl strip covered the glazing, careful examination of the windows prior to, and after, installation would have revealed the construction deficiency.

- (1) Identify the steps within the CQC system that failed, thereby creating the construction deficiency.

- (2) Identify the steps within the government's QA system that failed to detect the breakdown in the contractor's QC system.

- (3) Keeping in mind that there are 4,200 windows involved in the contract, what corrective measure should the resident engineer employ?
 - (4) What action should be taken on remaining buildings not completed?
 - (5) Assume, because of the magnitude of the problem, that the contractor and window manufacturer refuse to comply with your directive; what tools in the contract does the resident engineer resort to?
- c. Contract is for a large barracks complex involving 47 buildings. There are 1,500 fan coil units to be installed throughout the project. As the fan coil units were delivered to the site, the mechanical subcontractor discovered that the units contained 1/2" valve in lieu of a 3/4" as indicated on the contract drawings. Contractor's shop drawings also indicated a 3/4" valve. Contractor immediately advised the resident engineer of the discrepancy. The contractor further advised that the

supplier's standard unit is furnished with a 1/2" valve and requested permission to use units as delivered. All units were delivered in one large shipment, and some were needed for immediate installation.

(1) Was the subcontractor quality control system working?

(2) Where does the supplier fit into the problem?

(3) What measures should government QA personnel now employ?

(4) In this instance, should the resident engineer investigate possible design error in specifying a 3/4" valve?

d. Project includes several masonry buildings requiring joint reinforcement. Contractor proceeded with sample masonry panel erection without approved materials despite government QA personnel objection. Contractor has now completed wall erection on one building and government QA personnel discovers the contractor is using wrong joint reinforcement. Contractor superintendent states bar joists will be erected tomorrow morning.

(1) What questions first come to mind as to the effectiveness of the contractor's quality control system?

(2) Where did the government's quality assurance role first break down?

(3) What Contract Clauses should be employed by the resident engineer at this point in time?

e. Project is a small flood control dam with reinforced concrete outlet structure. Contractor testing requirements are specified in detail, and require full-time quality control personnel at concrete batch plant. Concrete production has commenced, and after one week concrete cylinder breaks indicate extremely low compressive strength. It is immediately discovered that the plant measuring devices had not been calibrated.

(1) What is the government's first corrective action to be taken?

- (2) What apparent deficiency existed in the contractor's quality control system?
 - (3) Basically, where did the government quality assurance role fail?
 - (4) What Contract Clauses must now be employed by the government?
- f. On an underground electrical distribution project, the contractor was to install a run of 2/0 cable in the system. The project had been completed and accepted two years ago, when it was discovered that this run of cable was #2 instead of 2/0 and totally inadequate for the future load.

(1) What corrective measure, if any, is available to the government to have the deficient cable replaced?

(2) Should the contractor's quality control system and government's assurance system prevent isolated instances of this type? How?

g. The contract for construction of the outlet works at a flood control and recreation reservoir required steel gates. The gates were subcontracted by the prime contractor to a fabricator in Los Angeles. All CQC requirements on the gates were delegated to the fabricator. The resident engineer arranged for government periodic QA visits to the plant. The plant inspector advised the resident engineer that the welding procedures and the welders had not been certified prior to commencement of fabrication. The QC contained no entry on this subject.

(1) In this instance, what role does the prime contractor assume?

(2) Where did the prime contractor fail in the quality control system?

(3) Where did the government's QA role break down?

(4) What steps does the government take now?

- h. The contract was for construction of multipurpose classrooms at the Air Force Academy. The rooms were to receive carpet which had been color-coordinated with the room furnishings. Carpet was scheduled for delivery August 1, which allowed only 3 weeks for laying and completion of project prior to start of classes. Carpet was delivered August 1, and it was immediately discovered that the carpet did not adequately match the approved sample.

(1) Could the CQC system have prevented this? How?

(2) Did the government fail in its QA role by not inquiring as to the status of carpet manufacture?

(3) What steps should the government take now?

- i. Contractor on a major multibuilding project started his first concrete placement this morning. Contractor is placing a monolithic foundation using a leased concrete pump truck. Two-thirds of the foundation had been placed when the concrete pump failed. No standby placement equipment was available as required by the contract, which created a cold joint before the pump could be repaired.

- (1) What was the first step that failed in the contractor's QC program?
- (2) How could the government's QA role have prevented this incident?
- (3) Would proper QC reports alert to a failure of this type in the system?
- (4) What corrective measures should the government employ to prevent further incidents of this type?

- j. An airfield project involved placement of a concrete apron for helicopters. The specifications required the use of jet fuel-resistant joint sealant. The sealant was required to be government tested and approved prior to use. The specifications further required that the joints be sealed immediately after the curing period. Contractor started placement of concrete when it was discovered that the sealant had not been submitted for testing.

(1) In what meeting should the testing requirements of the contract be discussed in general?

(2) At what phase should this specific testing have been discussed?

- (3) Within the government's QA role, where should we have detected this deficiency?

- (4) What corrective measures does the resident engineer use now?

Optional Module 8: THE RESIDENT MANAGEMENT SYSTEM (RMS)

Submodule 1: Introduction and Overview

Objectives: After completing this submodule, you will be able to:

- Identify the Corps' standard software package used on construction projects.
- List the benefits of the Resident Management System.
- List major output products of the Resident Management Systems.

A. Introduction:

In a growing number of construction field offices, the Corps of Engineers utilizes a software package known as the Resident Management System (RMS). This software has been implemented as the Corps' standard nationwide. It automates and simplifies many of the project administration activities. Some of these activities relate to Contractor Quality Control. This module is included for those QC representatives who will be on projects using this system.

B. Two Input-Output Approaches:

- The RMS system can be utilized in two ways relative to the Contractor-Corps quality management interface.
 - The first approach is for the Corps to maintain data on the Corps' Resident Office computers. The Corps inputs data taken from such documents as contractor daily reports, transmittals, correspondence from contractors or others, schedules, pay requests, lists of tests, and other similar submitted data. This is done on what is referred to as the "RMS" software.
 - The other approach is for the Corps to provide a software package, at no cost, to the contractor for his use in his jobsite field office. This is referred to as the "QC-RMS" software. In this approach, many of the features are further automated for contractor use. The contractor sends data updates to the Corps on a regular basis by E-mail or by providing a computer file update on disk.

- For the above two approaches most data management activities are substantially the same. The only difference is providing cross communication by a computer disk file or this same information on a piece of paper.

C. Benefits:

- Reduces typing. Once data is entered one time on easy to use input screens, the computer draws on that data for a wide variety of input-output products. Many items are either drawn from other databases (such as Network Analysis data), or selected through "look-up tables" eliminating the need to completely type them.
- Merges data drawn from RMS databases to produce useful tools to perform QC functions.
- Provides reminders for key suspense items and data.

D. Major CQM Output Products of RMS:

- Preconstruction Conference and Coordination Meeting minutes and agenda.
- QA and QC Plans.
- Submittal Registers, submittal tracking, and completed (filled in) Transmittal Forms.
- Three-Phase Control checklists, agenda, and meeting minutes.
- A deficiency tracking system.
- Daily QC Reports and QA Reports.
- Various closeout documents (including Installed Property, Transfer Property, User Schooling, etc.).

E. Other RMS and QC-RMS Software Features:

- The software tracks pay estimate data, and generates pay requests. It carries in the database all the scheduling activities and accepts a wide variety of Network Analysis Systems data input. Other features include the ability to track a variety of personnel data, subcontractor

listings, correspondence, RFI, and safety items. The software includes the complete Corps Safety and Health Requirements Manual EM 385-1-1, and can search on keywords to quickly find subject matter from the safety manual.

- In the early phases of the project, the Corps' office using RMS will provide blank or partially blank (paper) forms. (If QC-RMS is used, the contractor would type his portion of the data directly into the computer input screens of the software). Because the lists of data are being developed at the beginning of the job, the software allows the QC staff to effectively manage an assortment of QC items.
- Once the various planning lists mentioned above are created, they can be automatically printed onto the QC plan document at the appropriate place. All management personnel's names automatically appear in the text where they should. Examples of current forms and plans are available from the local Corps office.

EXERCISE

Submodule 8.1

1. What is the Corps' standard software package used on construction projects?
2. What are the benefits of RMS?
3. What are the major output products of RMS?

Optional Module 8: THE RESIDENT MANAGEMENT SYSTEM (RMS)

Submodule 2: Quality Control Components

Objective: After completing this submodule, you will be able to:

- Describe three major QC components included in RMS.

A. The Three-Phase Control Agendas and Databases:

- The Preparatory, Initial, and Follow-up Control phases play a key role in the overall QC program. Included in RMS and QC-RMS is a large database of two kinds of useful contractor management data: (1) A repetitive deficiencies list from years of similar Corps projects, and (2) A list of other requirements that have been flagged as worth special attention (referred to as "checks"). There are now over 12,000 of these individual items included with the software. They are all already linked to the categories of work (definable features of work). Once a feature of work is selected (from the available list), the system generates an agenda for preparatory or initial control phase meetings. This agenda includes a comprehensive checklist of accumulated knowledge on this one subject area to review at the meeting.
- In addition, the Corps and Contractor QC/QA team can go through the job drawings and specifications at any time and make additions to the list of items of special interest on any contract. The computer will place the information on the appropriate form or meeting agenda.
- Other items automatically provided on the meeting agenda form for the CQC representatives' use are applicable tests, submittal status, and relevant contract data, such as schedule activities.

B. The Submittal Process in RMS:

Using RMS, the process of tracking and managing submittals becomes easier. Once a submittal is in the system, it never needs to be re-described. Once dates and action codes are in, the various output documents make tracking easy for QC personnel. The software can carry over any submittal dates to corresponding items in the Network Analysis System. Items not yet resolved (the un-submitted and the unapproved submittals) "pop up" with reminders in appropriate places, such as at preparatory meetings and on Pay Estimate Review Sheets. The computer

automatically generates Transmittal ENG Form 4025, complete with all the contract data and items selected for the transmittal.

C. The QC Deficiency Tracking System:

The QC-RMS software includes a data management feature for entering and keeping track of deficiencies found on the project, sorting by various categories, and managing resolution of the items. A similar feature is found in the Corps' RMS software for tracking their QA comments over the course of the project. Both the Corps (by its regulations) and the contractor (by the provisions in the contract) are required to maintain a formal deficiency tracking system. This requirement is fulfilled by implementing these software tools. The process involves using straightforward data input screens and a variety of structured output reports.

D. Summary:

The information included in these submodules only provides an overview of the software, and general observations on the major components applicable to the CQC job duties. Specific local training and continuing guidance will be provided on the jobsite by the Corps' field office staff where RMS has been implemented.

EXERCISE

Submodule 8.2

What are three major QC components included in RMS?

LIST OF ACRONYMS

ABC	Associated Builders and Contractors
AGC	Associated General Contractors
CADD	Computer-Aided Drafting and Design
CC	Contract Clauses
CQC	Contractor Quality Control
CEGS	Corps of Engineers Guide Specifications
CQM	Construction Quality Management
DoD	Department of Defense
ENG Form	Engineer Form
EM	Engineer Manual
EP	Engineer Pamphlet
ER	Engineer Regulation
FAR	Federal Acquisition Regulations
FIO	For Information Only
GA	Government Approved
HQUSACE	Headquarters U.S. Army Corps of Engineers
ISO	International Organization of Standards
NAS	Network Analysis System
O&M	Operations and Maintenance
QA	Quality Assurance

QAR	Quality Assurance Report
QC	Quality Control
RFI	Request For Information
RMS	Resident Management System
VE	Value Engineering
VECP	Value Engineering Change Proposal

REFERENCES

It is highly recommended that copies of the following references be obtained to be used with this guide.

CONTRACT CLAUSE, DEFAULT (FIXED-PRICE CONSTRUCTION),
FAR 52.249-10.

CONTRACT CLAUSE, INSPECTION OF CONSTRUCTION, FAR 52.246-12.

CONTRACT CLAUSE, MATERIAL AND WORKMANSHIP, FAR 52.236-5.

CONTRACT CLAUSE, PRECONSTRUCTION CONFERENCE, FAR 52.236-26.

CONTRACT CLAUSE, SITE INVESTIGATION AND CONDITIONS AFFECTING
THE WORK, FAR 52.236-3.

CONTRACT CLAUSE, SPECIFICATIONS AND DRAWINGS FOR
CONSTRUCTION, FAR 52.236-21.

CONTRACT CLAUSE, SUPERINTENDENCE BY THE CONTRACTOR,
FAR 52.236-6.

CONTRACT CLAUSE, VE -- CONSTRUCTION, FAR 52.248-3.

CEGS 01300, SUBMITTAL PROCEDURES.

CEGS 01440, CONTRACTOR QUALITY CONTROL.

EM 385-1-1, SAFETY AND HEALTH REQUIREMENTS MANUAL.

EP 11-1-4, VALUE ENGINEERING BENEFITS AND THE CONSTRUCTION
CONTRACTOR.

EP 415-1-261, QUALITY ASSURANCE REPRESENTATIVE'S GUIDE.

EP 715-1-2, A GUIDE TO EFFECTIVE CONTRACTOR QUALITY CONTROL.

ER 1180-1-6, CONSTRUCTION QUALITY MANAGEMENT

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EXERCISE ANSWER KEY

Submodule 1.1

1. In construction, what establishes the quality requirements?

The quality requirements are established by the plans and specifications.

2. What is the purpose of CQM?

The purpose of CQM is to achieve the quality established by the plans and specifications, through the cooperative but separate efforts of contractor and government personnel.

3. Define CQM:

CQM is the performance of tasks which ensure that construction is performed:

- according to plans and specifications,
- on time,
- within a defined budget.

4. What are the two principal areas of CQM activity? Define each.

The two principal areas of CQM activity are contractor quality control (CQC) and government quality assurance (QA).

CQC is the successful execution of a realistic plan to certify quality construction and to preclude the problems resulting from poor quality. In this function, the contractor defines procedures to manage and control his:

- own activities,
- all subcontractors' activities, and
- all suppliers' activities.

QA is the means by which the government protects its interest by assuring that CQC is working effectively and that the end product complies with the quality established by the contract.

5. What are the benefits of CQM to the contractor? To the government?

To the contractor, the benefits of CQM are satisfactory performance, profit, better communication, planning and increased production.

To the government, the benefit of CQM is getting our money's worth.

6. What two factors have caused the construction industry to become highly specialized?

The two factors are:

- a changing market, and
- increased technology and regulation.

7. Why are construction projects difficult to manage?

Construction projects are difficult to manage because:

- construction projects are unique, and are not easy to standardize,
- assembly line approaches are hindered by operations involving many nonrepetitive skills, and
- environmental conditions cannot be controlled.

8. What factors will influence both the government and the construction industry in the future?

Influencing factors will be:

- new government regulations,
- greater customer influence,

- emergence of improved quality control and quality assurance managers,
- the development and increased use of construction-oriented management information systems,
- formal partnering,
- increase in contractual requirements for data automation,
- conversion to metric units and metric size components, and
- international competition will introduce ISO 9000 series standard of quality management.

Submodule 1.2

1. What factors have contributed to the misunderstanding of CQC?

This misunderstanding originated from an absence of guidelines for implementing the system, thereby resulting in a jumble of management methods. The Contract Clause further contributed to this misunderstanding by implying that CQC would duplicate the government's historical inspection activities.

2. What is the difference between INSPECTION and CONTROL?

INSPECTION is the process by which ongoing and completed work is examined. INSPECTION is ongoing or "after-the-fact."

CONTROL is a continual system of planning activities to ensure that the contractor is properly prepared to begin a phase of work and that he follows through in accomplishing the work in accordance with the contract. CONTROL is "preventive."

3. Who has contractual responsibility for quality control?

Contractual responsibility for quality control rests with the contractor. Although the contracting agency and the owner are vitally interested in quality control, responsibility for quality control belongs with the contractor.

4. Is the following statement TRUE or FALSE: "CQC is principally concerned with Inspection?" Explain.

The statement is FALSE. CQC is principally concerned with control.

5. How does the contractor benefit from effective CQC?

Contractor benefits are:

- reduces tear out and replacement costs stemming from deficient workmanship and materials,
- causes work to be done correctly the first time,
- earlier completion,
- reduces field overhead,
- greater profits,
- improves reputation for performing quality, on-time, cost-effective work, and
- improved safety, which means less lost-time, fewer insurance claims.

6. Name the benefits of effective CQC that accrue to the government.

Benefits to the government of effective CQC are:

- manpower is more effectively used,
- reduces deficiencies and corrective efforts, which means less recording and follow-up on deficiencies and correction, leading to earlier completion,
- improves public relations and customer satisfaction, and
- produces pride in the delivery of a quality product.

Submodule 1.3

1. What are the QC responsibilities of the contractor?

Contractor's QC responsibilities include:

- producing the quality specified in the plans and specifications,
- developing and maintaining an effective CQC system,
- performance of all control activities and tests, and
- preparation of acceptable documentation of CQC activities.

2. What are the responsibilities of the contractor's onsite representative?

The contractor's onsite representative's responsibilities are:

- overseeing the CQC system, and
- having full authority to act for the contractor on CQC matters.

3. What are the QA responsibilities of the government?

Government QA responsibilities include:

- requiring the specified standard of workmanship possible with the specified materials and within the limits of the contract.
- conducting onsite business only with authorized contractor representatives—not normally deal directly with individual craftsmen or subcontractors, but coordinate through the prime contractor.
- advise the contractor and document any deficiencies.

4. Name the items upon which a partnering relationship are based.

Trust, dedication to common goals, and an understanding of each other's individual expectations and values.

Module 2

1. Name three instances of contractor extensions of design:
 - pre-engineered metal buildings
 - fire alarm and protection systems
 - cathodic protection

2. Name some possible areas that must be addressed during the construction coordination review of plans and specifications.
 - Site conditions and restraints: Check for proper utility interface with existing facilities. Verify locations of utilities in the facility, waste disposal, site location, site survey control point, etc.
 - Proper allowance for maintenance space and access: The contractor shall prepare layout drawings of equipment to assure that adequate maintenance access has been provided.
 - Conflicts and discrepancies between plans and specifications.

3. The following (3A through 3F) are extracts from specifications and drawings for a recent designed project. They all contain errors, omissions, or inconsistencies that were discovered during the review. Examine the "highlighted" area(s) of each, and indicate what clarification is needed.

Exercise	Clarification Needed
3A	Describe type and size of pole.
3B	Indicate where underground markers will be relocated and specify whether lines are to be moved or not.
3C	Describe size and thickness of concrete pad that is to be demolished and whether or not it is reinforced.
3D	Indicate the number of 25,000 and 30,000 gallon tanks.

Exercise	Clarification Needed
3E	What is the size, configuration, and type of metal of the gutter and down spout.
3F	Either "TOP EL. 1774.00" or "FLOOR EL. 1776.25" must be wrong. Check other sources to determine the error, and indicate the required change on the drawing.

Submodule 3.1

1. Define the Quality Assurance Plan.

The QA Plan is a government document used as a management tool.

2. Define a Quality Control Plan.

A QC Plan is a detailed outline of the contractor's planned QC procedures. It is the foundation upon which quality work is based.

3. Name the components that must be addressed by the Quality Control Plan.

Required components of the QC Plan are:

- QC organization, including a chart showing lines of authority, QC staffing,
- qualifications of individual QC personnel, this includes subcontractors and supplier personnel assigned QC duties,
- a list of definable features of work,
- three phases of control,
- the handling of submittals,
- delegated QC duties,
- procedures for performance of QC testing,

- QC testing methods,
 - procedures for giving advance notice to the government for the conduct of tests,
 - assignment of a single QC representative,
 - procedures for tracking construction deficiencies,
 - procedures for completion inspection,
 - documentation procedures, and
 - completion turnover procedures.
4. Name the actions that must be accomplished relative to the QC Plan before construction can begin.

The QC Plan must be received, reviewed, and accepted by the government before construction can begin.

5. Name the phases of the "Three-Phase Control," and indicate when each is implemented.
- The Preparatory Phase - when advance planning and checks are being performed prior to construction beginning on each definable feature of work.
 - The Initial Phase - when the operation begins.
 - The Follow-up Phase - while work is in process.

Submodule 3.2

This is an example of a QC Plan, but it is not complete. Review this plan and comment on how it could be improved to meet the contract requirements.

Letters of Authority and Qualifications of Personnel

1. No organization chart of the lines of authority and CQC Personnel.

2. Although Mr. McCray is appointed to the Quality Control Position, it is not clear whether he is the Quality Control System Manager or a member of the Quality Control staff.
3. Spec paragraph 3.3.2.2 requires resumes, duties, etc., of each person assigned a QC function.
4. The Quality Control support team consisting of the superintendent and Keyes' Project Managers are designated as CQC but resumes, etc., are not included.
5. Letter of authority did not state he had authority to stop deficient work.

Quality Control Plan

1. 2.0-C (Policy) should state that notification of deficiencies begins with the foreman, then superintendent, and then Project Manager. This should not occur because all people should know that the CQC has the authority to reject non-compliant work.
2. 3.1 (Quality Control System Manager) yet another term without contractual meaning further confusing the CQC staff. We still do not know who the CQC system manager is.
3. 3.2 (Contractor's other personnel) The government should review and approve whether the contractor's superintendent is qualified or has time to function as CQC staff.
4. 4.1-A (Preparatory Phase) Contract specifications require a review of contract plans.
5. We find no evidence of government approval of CQC test lab.

6. The Daily report has no space for "Visitors Today".
7. No list of QC tests are provided.

Module 4

1. What is the objective of the Preconstruction Conference?

The objective of the Preconstruction Conference is to review the contract clauses to include accident prevention, personnel requirements, and procedural matters.

2. Why is the Preconstruction Conference important?

The Preconstruction Conference is important because it establishes the ground rules for administering the contract.

3. Who schedules, convenes, and conducts the Coordination Meeting?

The meeting is scheduled, convened, and conducted by the government. Normally, this is the area, resident, or project engineer.

4. What are the primary purposes of the Coordination Meeting?

There are three primary purposes of the Coordination Meeting:

- a. to achieve a mutual understanding with the contractor of his QC role,
- b. to review the QC Plan with the contractor, and
- c. to establish a good working relationship between the government and the contractor.

5. Who attends the Coordination Meeting?

Attendance to the Coordination Meeting should include all government, contractor, and subcontractor personnel who will be involved in construction quality management.

Module 5

1. What is the purpose of submittals?

Submittals are required by the contract in order to regulate the timely flow of materials to be incorporated into work. All required submittals must be provided in time to allow for review, approval, procurement, delivery, and CQC preparatory phase of an item before it is needed for construction. Submittals are indispensable in assuring and controlling construction quality and must be given the attention required.

2. What is the process the contractor must use to request a variation?

Variations must be noted on ENG Form 4025 and fully described, identified, and justified in the transmittal package.

3. What are the contractor's submittal responsibilities?

The contractor's responsibilities are:

- to integrate the submittal process into his QC Plan and delegate submittal responsibilities to the proper individuals on his staff,
- to be aware that the government considers the handling of submittals to be important,
- to ensure that all submittals are in full compliance with the contract,
- to review the government prepared Submittal Register and add any needed additional submittals,
- to check the submittal schedule requirements against the NAS or other approved construction schedule,
- to maintain and adjust dates on the register as required by the contract activities to ensure the document reflects current information,
- to ensure that all variations must be fully described, identified, and justified in the transmittal package,

- to assure that work is not permitted to begin without properly approved submittals, and
- to ensure compliance with the "Buy American Act - Construction Materials."

4. What are the government's submittal responsibilities?

The government's responsibilities are:

- to prepare a list of submittals (on ENG Form 4288) required for each contract,
- to review a minimum of 10% of "For Information Only" submittals,
- to review and approve submittals that require "government Approved" (GA), and
- to enforce submittal requirements.

5. What information must the contractor provide in his submittal control document (ENG Form 4288 - Submittal Register)?

The following information must be provided by the contractor in the submittal control document (ENG Form 4288 - Submittal Register):

- the item number,
- the contractor schedule dates,
- the contractor action, and
- NAS Activity Code, when applicable.

Submodule 6.1

1. What is the primary function of QA?

The primary function of QA is to obtain completed construction that meets all contract requirements.

2. What is the role of QA personnel?

The role is to assure that the CQC system is functioning properly.

3. What is the primary function of CQC?

The primary function of CQC is the successful execution of a realistic plan to ensure that the required standards of quality construction will be met.

4. What are the roles of QC personnel?

- produce the quality specified in the plans and specifications,
- develop and maintain an effective CQC system,
- perform all control activities and tests, and
- prepare acceptable documentation of CQC activities.

Submodule 6.2

1. What is the primary purpose of the three-phase control system?:

The primary purpose of the three-phase control system is to require the contractor to plan and schedule the work to ensure that he is prepared to start each new feature of work.

2. Regarding the three-phase control system, what are the responsibilities of quality control personnel?

- Develop, schedule, and implement procedures for tracking control phase meetings for definable features of work in the QC Plan,
- Notify appropriate personnel of time, date, and agenda,
- Conduct meetings (Preparatory and Initial),
- Document actual discussions and provide minutes to attendees,

- Monitor work in place through follow-up phase,
- Conduct additional control phase meetings, as needed.

Submodule 6.3

1. What are the major components of the sample Quality Control Report in submodule 3.2.

Major components of the sample Quality Control Report are:

- type of construction underway,
- phase of the feature of work,
- locations and times of control activities,
- tests performed and results,
- submittal information,
- arrival of equipment and materials,
- offsite surveillance, and
- job safety.

2. How often are Quality Control and Quality Assurance Reports required?

Quality Control Reports are required daily; Quality Assurance Reports are required for each visit day.

3. Following (3a through 3e) are situations relating to documentation and three-phase control. Read the situations carefully, and respond to the requirement(s) accompanying each.

- a. The G. J. Company has a contract for rehabilitation of three barracks. The work consists primarily of addition of partitions and installation of A/C equipment and duct work. On the day duct work installation

started, the Daily Report stated: "Started installing duct work today. Everything looked okay." Is this report feature adequate? EXPLAIN.

NO! Following points should be recorded:

- (1) Were preparatory and initial phase meetings conducted and, if so, results of those meetings?
 - (2) Location of work accomplished.
 - (3) "Okay" is not a satisfactory explanation of contract compliance.
 - (4) Who is doing work? Subcontractor?
 - (5) What type of duct work?
- b. The G. J. Company continues work on rehab contract. Today's activities involve the continuation of insulating duct work. After several review sessions with the contractor with regard to proper documentation of activities, his comments were, "Insulation of duct work being done in accordance with specifications. Vapor barrier was ripped in a couple of places and insulator was a little light in use of staples." Rewrite the contractor's comments to make them acceptable.

Following items should be included in the comments:

- (1) location of work,
 - (2) reference to review sessions,
 - (3) was ripped vapor barrier repaired and how?
 - (4) were additional staples added? and
 - (5) actions taken to prevent recurrence.
- c. The Paw Power Construction Company has a contract for construction of a high-rise administration building. Work was in early stages of construction and a subcontractor had just completed backfilling sanitary sewer lines. The utilities sub foreman had been designated as CQC representative for this portion of the work. His report was attached to

the main report. A preparatory and initial phase had been performed and recorded earlier. This report stated, "All work completed in accordance with directions received at preparatory phase."

- (1) Is it permissible to accept subreports attached to the Daily Report? Yes. This should be discussed at the Coordination Meeting.
- (2) Is it permissible to reference preparatory phase? Yes, but date of preparatory phase should be noted to facilitate correlation.
- (3) Is anything missing? Location of work. Reference to specification requirements as well as preparatory phase. Test results of required tests.

- d. Results of Surveillance: Bowers installed base of manhole #2 approximately 10 ft. east of its correct location. Pipe between manholes #6 and #2 is being removed and the pipe between manholes #3 and #2 is being extended to new location for manhole #2.

- (1) What does this report say?
- (2) Rewrite the report so that it states clearly what is intended.

The lack of sufficient detail in this report leaves you wondering as to exactly what happened and what corrective action was taken. The statement would cause you to believe that manhole #2 was left in the incorrect location and the lines extended accordingly. Actually, what the contractor was attempting to state was that he removed the mislocated manhole #2 base and installed all structures in their proper location. Misunderstandings such as the above are not uncommon because of the lack of clarity in QC Reports.

- e. You are the QC System Manager. You are to begin installation of ceramic floor and wall tile. Both the floor and the wall are to receive a setting bed. The floor has floor drains and waterproofing has been completed. The wall has electrical receptacles.

- (1) Who would you want at the Initial Phase of the work?
 - Tile foreman and craftsmen.
 - Electrical subcontractor representative.

- Mechanical subcontractor representative.
 - General contractor representative.
- (2) What would you check?
- Previous work on floor and wall substrates,
 - Quality of waterproofing,
 - Floor drain location and elevation,
 - Electrical receptacle installation,
 - Adequacy of ceramic tile materials including tile, mastic, mortars etc.
 - Do the craftsmen understand the contract requirements.
- (3) What items should be contained in the QC Report covering the Initial Phase?

Remembering previous discussions on the initial phase, the QC Report should cover the following, at a minimum:

- attendees,
- inspection of preliminary work,
- safety,
- establishment of level of workmanship, and
- resolution of any discrepancies raised.

Submodule 6.4

1. Define QC testing.

QC testing is that testing performed by the contractor to determine whether construction procedures are producing the desired contractual product.

2. Define QA testing.

QA testing is that testing performed by the government to verify that QC testing is adequate.

3. Who performs QC tests?

The contractor may use his own personnel and facilities or may employ an independent approved testing laboratory.

4. Who performs QA tests?

QA tests can be performed by:

- government personnel using the contractor's equipment and facilities.
- an independent testing laboratory, or
- field office, district or division government laboratory.

5. What questions should be answered before testing begins?

- Has all required testing been identified?
- Are test reporting requirements understood?
- Have laboratory facilities and testing equipment been verified as acceptable?
- Are laboratory personnel qualified?
- Has the calibration of equipment been verified as accurate?
- Is there a procedure for documenting corrective steps?

Submodule 6.5

What is the appropriate chronological order for quality management completion procedures listed in this submodule? Explain.

1. **Warranty - Documentation of warranties**, if any, are provided to the government at submittal time.
2. **O&M Manuals - Instruction on preparation of equipment** must be obtained and understood prior to turning it on. Likewise, if equipment is to be operated correctly, the recommended maintenance of it is necessary to obtain its maximum life.
3. **Testing of Completed systems - Mechanical and electrical systems** must be proof-tested to prove or ensure such systems will function as intended.
4. **Instruction and Training Procedures - After systems have been proof-tested**, proper operation and maintenance of systems is demonstrated to customer O&M personnel utilizing previously prepared manuals.
5. **Contractor Punch-Out - Procedure required for entire project or portions thereof** prior to pre-final inspection.
6. **Pre-Final and Final Inspections - Procedures required for acceptance of a project or portions thereof** by the government.
7. **Materials Turnover - Executed at the time of turnover of acceptable work** to the customer.
8. **As-Built Drawings - Created throughout the life of the project**, but provided to the government at completion.

Module 7

1. **Name the categories of problems that normally occur during construction.**

Problems during construction normally fit into the following categories:

- **delays,**
- **planning and control,**
- **testing,**
- **documentation, and**
- **misunderstanding of CQC responsibility.**

2. What options are available to the government under the Contract Clauses of the contract?

Government options are:

- Requiring the contractor to remove and replace deficient materials and/or workmanship.
- Withholding payment.
- Requiring removal of unqualified personnel.
- Requiring the contractor to assume personal supervision.
- Halting work.
- Issuing an unsatisfactory performance appraisal.
- Terminate the contract.

3. Analyze the cases on the following pages and answer the questions included with each. Be prepared to discuss your answers with other members of the class.

- a. Contractor is constructing a commissary. The contract was awarded in April, which allowed for sufficient time to enclose the building before onset of cold weather. Building is scheduled to be complete in May of next year, which necessitates doing the inside finish work during winter months. The customer has scheduled delivery of equipment and stock for June. Work was progressing satisfactorily and the contractor was about to start roofing operations in mid-September when the resident engineer discovered the contractor was installing untreated lumber for edge strips, curbing, etc., which was in violation of the specifications. Work was stopped, and after some investigation, contractor advised the resident engineer that the best delivery on treated lumber was eight weeks, which would delay enclosing the building and ultimately delay turnover to the customer. The contractor requested waiver of treated lumber requirement.

- (1) Where did the contractor's control system break down?

Obviously an effective Preparatory Phase meeting should have addressed the subject of "treated lumber" as this has been historically a repetitive problem in roofing operations. Further, the specifications usually require certain contractor submittals on treated lumber. Therefore, the contractor's CQC system failed from the absence of, or an inadequate Preparatory Phase meeting.

- (2) Where did the government assurance system break down?

The government's system broke down when by not assuring that the contractor had conducted a proper Preparatory Phase. Further, it should have been noted from an examination of the contractor's QC reports the lack of this important phase. Also, the government failed to monitor the submittal register.

- (3) What are the resident engineer's courses of action?

Pursuant to the terms of the contract, the resident engineer must now reject the improper material and require contract compliance. The resident engineer should also question, in writing, the adequacy of the Contractor's Quality Control system and require immediate management corrective action.

- b. Contract involves construction of a major barracks complex including 25 dormitories. Project is 75% complete and occupied by troops when the customer complains that the opaque panel in lower window section is allowing precipitation to penetrate during driving rain. The leaks have stained carpet and ceiling tile. Investigation reveals that leaking panels are improperly glazed and do not conform with the contract drawings or specifications. All windows had been factory glazed and were warehoused onsite. Although a vinyl strip covered the glazing, careful examination of the windows prior to, and after installation would have revealed the construction deficiency.

- (1) Identify the steps within the CQC system that failed, thereby creating the construction deficiency.

There was an absence of, or inadequate, Preparatory Phase meeting, which would have included examination of materials and comparison to shop drawings when materials were delivered to the jobsite. Because of the volume of windows involved, CQC directly related to offsite fabrication should have been addressed

during the Coordination Meeting. A visit by the contractor to the fabricator's plant during the fabrication process would have been in order.

- (2) Identify the steps within the government's QA system that failed to detect the breakdown in the contractor's QC system.

The government did not assure itself that the contractor had scheduled or conducted a Preparatory Phase. The government representative conducting the Coordination Meeting did not address the subject of offsite fabrication or examination of materials or equipment when delivered to the project site. QC Report review by QA personnel should have revealed lack of adequate Preparatory Phase.

- (3) Keeping in mind that there are 4,200 windows involved in the contract, what corrective measure should the resident engineer employ?

Contractor should be immediately advised in writing, by the Contracting Officer's Representative to cease installation of windows until compliance with the contract is demonstrated. Problem is of such a magnitude that Contract Clause, "Inspection of Construction," will be invoked formally to require the contractor to examine and expose an adequate sampling of windows throughout the project. It is possible the government may be liable for some payment if the examination reveals some contract ambiguity, but the severity of the problem is such as to warrant the risk.

- (4) What action should be taken on remaining buildings not completed?

The contractor should be required to immediately convene a Preparatory Phase meeting and all aspects of the window installation should be reviewed by the contractor in detail before any further work on this feature progresses. The contractor should be required to increase his QC surveillance until he demonstrates contract compliance.

- (5) Assume, because of the magnitude of the problem, that the contractor and window manufacturer refuse to comply with your directive; what tools in the contract does the resident engineer resort to?

The contractor should again be directed in writing by the Contracting Officer to correct the defective windows. A definite suspense date should be established in this letter for effecting the correction. The contractor should be advised that if correction is not accomplished by that date, pursuant to the contract, another contractor will be employed to make the correction and he will be backcharged for the cost. Further, a copy of this correspondence should be forwarded to the contractor's surety company. Many times, this generates immediate action. Reference to the payment Contract Clause and the Contractor Performance Appraisal may also create some activity on the contractor's part.

- c. Contract is for a large barracks complex involving 47 buildings. There are 1,500 fan coil units to be installed throughout the project. As the fan coil units were delivered to the site, the mechanical subcontractor discovered that the units contained a 1/2" valve in lieu of a 3/4", as indicated on the contract drawings. Contractor's shop drawings also indicated a 3/4" valve. Contractor immediately advised the resident engineer of the discrepancy. Contractor further advised that supplier's standard unit is furnished with a 1/2" valve and requested permission to use units as delivered. All units were delivered in one large shipment, and some were needed for immediate installation.

- (1) Was the subcontractor's quality control system working?

The subcontractor's quality control system was working. He had examined equipment immediately upon delivery to the job site and advised the prime contractor. However, the subcontractor might have visited the supplier's plant during fabrication because of quantity involved.

- (2) Where does the supplier fit into the problem?

The failure rests with the supplier for not correlating the shop drawing with the manufactured item. Again, because of the magnitude of the order, there should have been a closer communication between the supplier and the subcontractor. This is a breakdown in QC. The prime contractor is ultimately to blame

for not fulfilling the responsibility to assure the subcontractor and the supplier were communicating.

- (3) What measures should government QA personnel now employ?

QA personnel should instruct the contractor not to install any of the units until the problem is resolved.

- (4) In this instance, should the resident engineer investigate possible design error in specifying a 3/4" valve?

The resident engineer should investigate the possibility of a design error as the government normally specifies a manufacturer's standard unit. If a drafting error on the plan is discovered as the cause, a modification should be issued changing the 3/4" valve to 1/2" with an equitable credit to the government.

This case study demonstrates that each problem that arises must be judged carefully.

- d. Project includes several masonry buildings requiring joint reinforcement. Contractor proceeded with sample masonry panel erection without approved materials despite government QA personnel objection. Contractor has now completed wall erection on one building and government QA personnel discover the contractor is using wrong joint reinforcement. Contractor superintendent states bar joists will be erected tomorrow morning.

- (1) What questions first come to mind as to the effectiveness of the contractor's quality control system?

Obviously, the contractor has not employed an effective CQC system since the start of the project. Deficiencies such as depicted do not occur if proper preparatory phase was conducted.

- (2) Where did the government's quality assurance role first break down?

Basically, the government has failed in its Quality Assurance role by allowing the contractor to progress to this point without an effective CQC system. Government QA personnel have not employed the contractual remedies available to correct the situation before it deteriorated this far.

- (3) What Contract Clauses should be employed by the resident engineer at this point in time?
 - (a) Direct the contractor under the "Inspection of Construction" clause to cease masonry work until work has been corrected.
 - (b) Under the "Withhold Payments Contract Payment" clause withhold payment for any deficient work.
 - (c) Under the "Material and Workmanship" clause remove the contractor's QC representative as incompetent.

The contractor should be advised of all of the above in writing over the Contracting Officer's signature. The contractor should also be told that the resident engineer is considering the issuance of an interim unsatisfactory performance appraisal if improvement to the CQC system is not initiated.

- e. Project is a small flood control dam with reinforced concrete outlet structure. Contractor testing requirements are specified in detail, and require full-time quality control personnel at concrete batch plant. Concrete production has commenced, and after one week concrete cylinder breaks indicate extremely low compressive strength. It is immediately discovered that the plant measuring devices had not been calibrated.

- (1) What is the government's first corrective action to be taken?

The government must direct contractor to stop placement of concrete.

- (2) What apparent deficiency existed in the contractor's quality control system?

Lack of an adequate Preparatory Phase which would have addressed calibration of the plant.

- (3) Basically, where did the government quality assurance role fail?

Lack of an adequate Coordination Meeting which should have addressed calibration and testing, in general. It is apparent also that the government had not insisted that the contractor conduct a Preparatory Phase meeting prior to the start of concrete operations.

- (4) What Contract Clauses must now be employed by the government?

- (a) Require the contractor to demonstrate strength of concrete in place. If found deficient, require removal and replacement. (CC "Inspection of Construction")
- (b) Withhold all payment for placed concrete until situation is corrected. (CC "Withhold Payment - Contract Payment")
- (c) Caution contractor on competency of his QC representative. (CC "Material and Workmanship")

- f. On an underground electrical distribution project, the contractor was to install a run of 2/0 cable in the system. The project had been completed and accepted two years ago, when it was discovered that this run of cable was #2 instead of 2/0 and totally inadequate for the future load.

- (1) What corrective measure, if any, is available to the government to have the deficient cable replaced?

The Contract Clause "Inspection of Construction," states that acceptance shall be final and conclusive except for latent defects, fraud, gross mistakes amounting to fraud, or the government's rights under any warranty or guarantee. In this instance, this deficiency falls within the category of a gross mistake. Contractor's should be required to replace cable. Contractor's surety should be notified if contractor contests action.

- (2) Should the contractor's quality control system and government's assurance system prevent isolated instances of this type? How?

If a proper Initial Phase had been conducted, a problem such as this could have been avoided. Further, the Follow-Up Phase should have revealed the deficiency.

- g. The contract for construction of the outlet works at a flood control and recreation reservoir required steel gates. The gates were subcontracted by the prime contractor to a fabricator in Los Angeles. All CQC requirements on the gates were delegated to the fabricator. The resident engineer arranged for government periodic QA visits to the plant. The plant inspector advised the resident engineer that the welding procedures and the welders had not been certified prior to commencement of fabrication. The QC report contained no entry on this subject.

- (1) In this instance, what role does the prime contractor assume?

In this instance, the general contractor assumed a QA role as he has delegated the CQC responsibility to the fabricator.

- (2) Where did the prime contractor fail in the quality control system?

He no doubt did not outline the CQC requirements to the fabricator and in his QA role did not follow-up on the CQC procedures at the plant.

- (3) Where did government's QA role break down?

During the Coordination Meeting the subject of offsite fabrication was not thoroughly discussed so that the prime contractor fully understood his role. The government may have also noted the deficiency through a proper review of the daily QC reports.

- (4) What steps does the government take now?

The government must direct the contractor to cease fabrication until all required procedures have been met. Require the contractor to demonstrate contract compliance on previously fabricated work. Withhold payment on gates until contract quantity is satisfied.

- h. The contract was for construction of multipurpose classrooms at the Air Force Academy. The rooms were to receive carpet which had been color-coordinated with the room furnishings. Carpet was

scheduled for delivery August 1, which allowed only three weeks for laying and completion of project prior to start of classes. Carpet was delivered August 1, and it was immediately discovered that the carpet did not adequately match the approved sample.

- (1) Could the CQC system have prevented this? How?

Yes. If offsite fabrication and CQC requirements related thereto had been properly addressed, the prime contractor would have assured himself that the match was satisfactory during manufacture.

- (2) Did the government fail in its QA role by not inquiring as to the status of carpet manufacture?

Yes. In the government's QA role, it should continually question the contractor as to the status and quality of his offsite fabrication and procurement.

- (3) What steps should the government take now?

Reject the delivered carpet and insist on compliance. Coordinate the delay with the customer and reschedule carpet laying outside class hours to avoid conflict.

- i. Contractor on a major multibuilding project started his first concrete placement this morning. Contractor is placing a monolithic foundation using a leased concrete pump truck. Two-thirds of the foundation had been placed when the concrete pump failed. No standby placement equipment was available as required by the contract, which created a cold joint before the pump could be repaired.

- (1) What was the first step that failed in the contractor's QC program?

Total lack of Preparatory Phase and Initial Phase on concrete placement.

- (2) How could the government's QA role have prevented this incident?

In the government's assurance role they should know whether the contractor is following the three-phase control system on definable features of work. The lack of a Preparatory Phase

meeting on concrete should be discovered when examining the contractor's QC reports as these significant events should be recorded.

- (3) Would proper QC reports alert us to a failure of this type in the system?

Yes, all Preparatory Phase minutes should be recorded by the contractor.

- (4) What corrective measures should the government employ to prevent further incidents of this type?

Require the contractor to cease concrete operations until alternate equipment is available; require the contractor to convene Preparatory and Initial Phase meetings and thoroughly discuss all aspects of concrete placement. Review QC Report requirements with the contractor insisting that the three-phase system of control be recorded properly. Question the effectiveness of the contractor's QC representative.

- j. An airfield project involved placement of a concrete apron for helicopters. The specifications required the use of jet fuel-resistant joint sealant. The sealant was required to be government tested and approved prior to use. The specifications further required that the joints be sealed immediately after the curing period. Contractor started placement of concrete when it was discovered that the sealant had not been submitted for testing.

- (1) In what meeting should the testing requirements of the contract be discussed in general?

The Coordination Meeting.

- (2) At what phase should this specific testing have been discussed?

The Preparatory Phase meeting should address specific testing on the definable feature of work.

- (3) Within the government's QA role, where should it have detected this deficiency?

The government should have noted the lack of an adequate Preparatory Phase meeting. It's review of the contractor's QC Reports should be alerted to this problem. The review of the submittal register status should also reveal the deficiency.

(4) What corrective measures do we use now?

Cease concrete placement until the contractor demonstrates how he will satisfy contract requirements on future placement. Explore with the contractor the possibility of his voluntary use of a temporary seal on concrete previously placed until proper material has been tested. Ensure that any temporary seal is at no additional cost to the government.

Submodule 8.1

1. What is the Corps' standard software package used on construction projects?

The Resident Management System (RMS)

2. What are the benefits of RMS?

- Reduce typing,
- Merges data inputted with database to produce useful tools to perform QC functions, and
- Provides reminder for key suspense items and data.

3. What are the major output products of RMS?

- Preconstruction Conference and Coordination Meeting Minutes and Agenda,
- QA and QC plans,
- Submittal Registers, Submittal Tracking, and Completed (filled in) Transmittal Forms,

- Three-Phase Control Checklists, Agenda, and Meeting Minutes,
- A Deficiency Tracking System,
- Daily Quality Control Reports and Quality Assurance Reports, and
- Various Closeout Documents (including Installed Property, Transfer Property, User Schooling, etc.).

Submodule 8.2

What are three major QC components in RMS?

- Three-Phase Control Agendas and Databases,
- Submittal Process in RMS, and
- QC Deficiency Tracking System.